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Journal of the Society of Arts.

FRIDAY, MARCH 23, 1855.

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EXTRA-ORDINARY MEETING.

Monday, March 19, 1855.

An Extra-ordinary Meeting was held on the evening of Monday, the 19th inst., for the purpose of resuming the Discussion on Mr. J. B. Lawes' paper on "The Sewage of London." Colonel Challoner, as on the former occasion, presided.

The following candidates were balloted for, and duly elected Ordinary Members :—

Kite, James
Mackrell, William
Trueman, Charles,
Vernon, Henry

As Corresponding Members :—

Audley, Charles
Maelen, Phil. Van Der

DISCUSSION ON THE SEWAGE OF LONDON.

Dr. Alfred S. Taylor, in a note to the Secretary, says, "I have not given much attention to the subject lately, but Mr. Wicksteed's plan appears to me to be a very good one in many respects. It most effectually precipitates a large portion of the nitrogenous matters, and, to a very great extent, deprives sewage waters of their offensive smell. As to the fertilising properties, I think more reliance is to be placed on agricultural experiments, fairly tried, than on the precise results of chemical analyses."

Mr. Lawes said, considering the very late hour to which the discussion, after the reading of his paper on the 7th inst., was carried, he was unwilling then to avail himself of the privilege of making any reply to the remarks of the various speakers. He was not sorry, therefore, for the opportunity of offering some observations on the objections raised, which was afforded by the appointment of an extra evening for the further consideration of the subject. Looking to the manifest bearing of his paper, he must say, that he thought in the discussion the subject was looked at too much from the sanatory, and too little from the agricultural, point of view. With regard to the production of a *solid sewage manure*, he would only say, that if Mr. Wicksteed or any other person could in this way economically provide the farmer with the valuable constituents contained in sewage, he would confer a great boon upon agriculture by so doing. But Mr. Wicksteed had, under the advice of distinguished chemists, ignored chemical composition as a test of value; which, however, he (Mr. Lawes) could assure him was the test to which such productions would infallibly have to yield. Mr. Chadwick, in a long speech, in which he dealt very liberally in complaints and objections in detail, and in which he at the same time afforded confirmation of his (Mr. Lawes') views on many essential points, such as it must be very gratifying to receive from so high an authority, concluded by saying—"he had noticed the chief points in which there had been serious misapprehension, or oversights of existing information." True, the result arrived at was not attained by the aid, though certainly not in ignorance of, the "Minutes of Information, &c." Mr. Chadwick's first objection was to his (Mr. Lawes') argument, that the cost of carriage must regulate the distribution of solid manures; and he supported it by stating, that he had pointed out the same rule himself some years ago, and also by illustrating its influence in the case of guano as compared with the town manures of Liverpool. Mr. Chadwick complained, that whilst he (Mr. Lawes) showed that the carriage from London of a ton of solid manure to his farm at Rothamsted was fifteen shillings, he did not call attention to the fact, that a great many tons—72 according to Mr. Chadwick's calculation—of *liquid* manure could be brought to his land for the same money. Now, any one who had neither heard nor read his paper, would surely imagine that he (Mr. Lawes) was arguing against the use of town-sewage in a liquid form; whereas, the whole of his remarks on this cost of carriage, were intended to show that the distribution of the London sewage, in the form of a solid or portable manure, was impracticable; and that liquid distribution must, therefore, be relied upon. So far, then, his own views and those of Mr. Chadwick were perfectly identical. But Mr. Chadwick, whilst he argued that 72 tons of liquid manure could be carried for the same cost as the one ton of stable dung, overlooked the fact that he (Mr. Lawes) had shown that such was the composition of the dung in relation to its bulk, that he could not afford to carry it to his farm, even if it were given to him—and Mr. Chadwick had failed to show that his 72 tons of fluid would be of manurial value equal to its cost of carriage. On this point, he (Mr. Lawes) would, however, notice in passing, that if the 72 tons of sewage so delivered to him for 15s., were to be in the state of dilution, which existing facts led him to think it probably would be, it would contain only about seven-eighths of the average annual excrements of one person, which, allowing liberally, he had valued in the solid form at 6s.; and however ardent an admirer Mr. Mechi might be of water, he would, perhaps, agree with him (Mr. Lawes), that the extra cost of 9s. or 10s., would be paying rather dear for the solution of 5s. to 6s. worth of manure. If, however, as Mr. Chadwick maintained was possible, the sewage were four times this strength, he should get on his land for 15s. the annual excrements of 3½ individuals, worth in the solid from, according to the above estimate, 21s. Here, then, was the question. This brought him to notice Mr. Chadwick's estimates of the amount or bulk of the metropolitan sewer-water. Mr. Chadwick objected to the estimate of bulk and dilution arrived at, by assuming that, taking the increased water supply and rain-fall together, the amount of fluid reaching the sewers would give an average of 50 gallons per head per day. Mr. Chadwick stated, that first-class houses in the metropolis which had been gauged, and which were well provided with water-closets, showed a consumption of only 12 or 12½ gallons of water per head per day. Now, if Mr. Chadwick would engage to supply the farmers with liquid sewage at 2½d. per ton, in 12½ gallons of which there would be—besides extraneous matters—on the average the daily excrements of one individual of the population, he might venture to say, that he, (Mr, Chadwick,) need not be in want of customers. In this way, the farmer would get upon his land, and in the liquid form, the annual excrements of one individual of the population for a sum of 4s. 2d. But what were the facts of the case? According to a parliamentary return made last year, the supply of the water companies now amounted to 25 gallons per head per day, and they were about to increase that supply. The rain-fall, too, over the same area, gave an average, though very unequally distributed as to time, of nearly another 25 gallons per head per day; and on this point, Mr. F. O. Ward had confirmed his own (Mr. Lawes) estimate. Mr. Chadwick did not say that this was not a true statement of the existing facts of the case, but that it was an exaggeration of the *necessary* or *required* amount of dilution. He told us, that two-fifths only of the water supply was actually used in carrying off the house matters, and that the remaining three-fifths were worse than waste. The rain-fall again he ignored or invoked at pleasure, leaving out of his calculation altogether when wishing to limit the *necessary* dilution of the sewage, and calling it to his aid when he wished to add to its composition, the soot and excrements from the roofs and streets. Mr. F. O. Ward, however, had called particular attention to the *fact*, that the rain-fall does mix with the sewage matter; and further, that it does so, so irregularly, as to introduce one of the chief difficulties in the disposal of sewer-water. And when Mr. Chadwick said, that the useless three-fifths of the water supply was worse than waste, he (Mr. Lawes), supposed he meant, that though unmixed with its due proportion of valuable manurial matter, it still had to be dealt with in the disposal of the sewage. He was perfectly willing to grant, that if, as assumed by Mr. Chadwick, the water supply could, with due regard to cleanliness and sanatory efficiency, be reduced to a regular average of 12½ gallons per head per day, and that, if, as urged by Mr. Ward to be so desirable, the rainfall could be excluded from the sewage proper, a vast step would be gained towards the practicability of usefully applying the sewage of London. It was, however, notoriously not the fact, that the public had any grounds for supposing that these most desirable objects were in actual course of progress, or, in fact, that the execution of such plans was anything more than the proposition of individuals. It was not, therefore, a candid way of treating this question, to give the aspect of authority and of foundation upon existing fact, to estimates of the *necessary* or *required* amount of dilution of sewage, based on what were at present purely ideal systems, having no reference to existing and authoritatively recognised arrangements. Until, therefore, these desirable objects were practically realised, or, at least, officially decided upon, and in course of being so, he (Mr. Lawes) was bound to conclude that his estimate of the amount of fluid to be disposed of in dealing with the sewage of London would agree much more nearly with the actual and probable facts of the case than the assumption of Mr. Chadwick. But, further than this, we had it upon the testimony of Mr. Chadwick and Mr. Ward that a large proportion of the excessive amount of water would be discharged unmixed with manurial matters, for which, he supposed, equally with the stronger sewage, Mr. Chadwick would expect his 2d. or 2½d. per ton. Again, whilst Mr. Chadwick asserted that his (Mr. Lawes') estimate of the manurial constituents which *should* enter the metropolitan sewage was too low, he at the same time admitted that, owing to the want of water-closets, and other defective arrangements, by which a large portion of the human excrements even were not properly carried off in the sewer water, it was not in a state to reason upon. But, it would be obvious, the line of inquiry of his (Mr. Lawes') paper, was to determine chemically what elements of value were at the command of those dealing with sewage, and it was their affair, not his, to see that they duly availed themselves of all that was thus within their reach. Already, indeed, the strength and quality of sewer water had become a question between the seller and the buyer of it. For, it seemed, it was only the other day that Lord Essex, who rented the sewage of Watford, sent into the town the request that it might be made a little stronger! Until, then, we were clearly informed that the constituents which *ought* to enter the London sewage would really do so, and not only what was its *necessary* and *required* degree of dilution, but what this in practice actually would be, he thought the *vis inertiæ* which had been attributed to the farmer in this matter had better attach to him even a little longer. Mr. Chadwick's next allegation was, that he (Mr. Lawes) had much underrated the manurial value of sewage in assuming that, "The chief source of its valuable constituents must be the excrements of the population." That they would be the *chief source* of its *valuable* constituents, he nevertheless maintained. He could assure Mr. Chadwick, that none of the matters referred to by him were overlooked in a consideration of this question. With regard to the house refuse derived from food, he would remind Mr. Chadwick, that in his estimate he had already allowed for four-fifths of its most valuable constituents in the sewage, and that of the remaining fifth, of nitrogen at least, a certain portion remained in the body and was carried to the grave, whilst another portion was known to be exhaled into the atmosphere. By how much, therefore, of the fraction of the remaining fifth would Mr. Chadwick wish to increase the estimated value of sewage on account of the kitchen refuse that might reach it? In fact a knowledge of the proceedings of that "laboratory" would show, that a very small proportion of matters *valuable as manure* was derived from that source. The "fat" and "tallow" of sewer water, which Mr. Chadwick considered such a serious exclusion, was certainly next to worthless as manure, and he was sure, if any company were disposed to convert these matters into candles, the agriculturists would receive the residue without any deduction on that account. Of the soap, and the siliceous and alkaline matters from the streets, pretty nearly the same thing might be said. Of themselves they had little estimable money value; though as adjuncts to those constitutents which do determine the money value of manures, they were not destitute of some beneficial effects. Of the excrements of horses and other animals voided in the streets, a certain portion would also be removed in the same form in the sweepings, and the remainder, which must be a small proportion of the whole, he (Mr. Lawes) had granted would enter the sewers with the street washings. Of soot, too, the large proportion certainly was collected as a solid manure, and did not reach the sewers. So far then as to the existence, if not as to the value, of the extraneous matters in sewage, he did not differ from Mr. Chadwick. Mr. Chadwick, however, stated, that the quantity of street refuse reaching the sewers would increase with sanatory reforms. How far this would be accomplished with his (Mr. Chadwick's) supposed diminished water supply, and his total exclusion of the rain-fall from his estimates of the amount of fluid to be dealt with in the sewers, might, he imagined, be a question. The next point of objection was as to the area that would probably be required to receive the metropolitan sewage. The general conclusion to which his (Mr. Lawes') calculations as a whole had led him, and which he had stated in his paper, was, that if the metropolitan sewage were applied to grass, so far as an *à priori* judgment could be formed at all on this point, an area of 20,000 acres (equal to 31¼ square miles), might suffice for its utilisation. Now let us see how far Mr. Chadwick's estimate differed from this amount,—instead of from 3,500 square miles, which he (Mr. Chadwick) had apparently attributed to him. After referring to the experience of Edinburgh, Mr. Chadwick decided that Mr. Cuthbert W. Johnson's estimate of 38 square miles, equal to 24,320 acres, was the most applicable to the proposed conditions of London sewage, which had yet been made, and that beyond this, only a little extension to absorb surface washings, &c. would be necessary. Instead, therefore, of there being an enormous discrepancy between Mr. Chadwick's estimate and his own on this important point, the coincidence between them was somewhat remarkable. With regard to this point it was true, however, that the greatest difference of opinion did exist between the estimates of different individuals. Thus, Mr. Wicksteed, and the late Mr. Smith, of Deanston, supposed that about 150 tons of sewage would be sufficient for an acre. This, according to his (Mr. Lawes') estimate of the bulk of London sewage would contain less than the annual average excrements of two persons, and at 2d. per ton for the fluid would cost about 25 shillings. In the instance given by Mr. Cuthbert W. Johnson, the sewage was applied at a rate of that of 30 persons to the acre; this would amount to about 2,450 tons of liquid per acre per annum, costing, at 2d. per ton, more than £20 for the annual dressing of sewage. But Mr. Johnson thought that the area implied in these amounts might be reduced to one-third, and in this opinion Mr. Chadwick concurred. At this rate the annual excrements of 90 persons would be put upon an acre of land, at a cost of more than £60. Mr. Morse, again, estimated that the sewage of 1,000 persons might be put upon an acre, which, reckoning the same rate of dilution, and the same price per ton for distribution as before, would amount to about £680 per acre! These calculations were perhaps sufficient to show what was the degree of probability that we should ever be able remuneratively to distribute the total sewage of London by a system of pipeage. This brought him lastly to Mr. Chadwick's remarks as to the crops to which the application of the metropolitan sewage was suitable. Mr. Chadwick maintained that the experience of Mr. Pusey, Mr. Mechi, and others, of the greatly increased production of corn and root crops obtained by dissolved as compared with solid manures, and the well-known physiological fact, that no plants took up their food in the solid form, were sufficient proofs of the applicability to all crops of town-sewage. He must beg entirely to differ from Mr. Chadwick as to the legitimacy of deductions, as to the *practical* and *economical* application of enormous bulks of dilute town-sewage, from any such data. The economization of the area of distribution so as to get the greatest possible concentration of produce on a limited area of land, was surely a main element in the economical application of the metropolitan sewage. And, certainly, no considerations of the efficacy of small amounts of fluid applied at given periods of the year with special objects—whether these be the manuring of land previous to the sowing of corn, or the saving a crop during a drought—were in any way admissible in this question, in which was involved the disposal, not of a limited and discretionary, but of an enormous and constant supply of fluid with a capital-outlay equally great for the distribution, whether of a large or small amount. For, it must be evident, that the amount of liquid which could with advantage be applied to land under corn, &c., and the periods of the year of its application, were such crops to any great extent relied upon, would be, as compared with those of *permanent grass*, so limited, that, therefore, the capital-outlay in pipes, or otherwise, must necessarily be much less remunerative than in the latter case. And, it was for similar reasons, that as Italian rye-grass implied a return to tillage, the cultivation even of this enormously rapid grower under liquid manuring, would not seem to offer so permanent and constant a demand for the sewage over a given area, as the less productive but permanent grasses. How far, however, a judicious interspersion of land under other crops than permanent grass might prove advantageous, for the purpose merely of absorbing the sewage during periods when it might not be applicable to the latter, was another question. But there was another point in connection with this subject to which he would particularly call attention, and which strikingly illustrated the desirableness of infusing a little of the experience of agricultural chemistry into estimates of the area and crops to which town-sewage was economically applicable. Mr. Chadwick took exception to the application of data derived from experiments with solid manures, for the purpose of deciding the comparative value of different substances; for, as he said, the constituents of manure were known to be taken up by plants only in a state of solution; and, further, that a given amount of them produced a much greater effect when applied to the land in this form. Now, how were these principles relied upon in Mr. Chadwick's, he thought judicious, limitation of the area for the application of liquid sewage to about 25,000, or we would even say 30,000 acres? And still further, how were they exemplified in his inclusion in that area of any considerable breadth of corn? According to his estimate of the human excrements alone—which, however, Mr. Chadwick said was too low—the average amount of ammonia per acre, if the whole were put upon 30,000 acres, would be about 800 lbs. per annum! He (Mr. Lawes) had already said, that about half a cwt. of ammonia was an ordinary artificial dressing for a corn crop; and certainly twice that amount, even if applied in the solid form, was more than the average of our soils and seasons would bear, without over luxuriance and the crop being laid. How would it be, then, if even this amount only were applied in the liquid form? But Mr. Chadwick, who so strongly urged the vastly greater efficacy of the liquid form, would either apply in that way seven or eight times as much as the crop would bear of the solid manure, or an equal cost in pipeage must be incurred for the application of one-tenth or less of the amount of sewage appropriated to those portions of the area under grass; in which case, a proportionally larger share of fluid must be deposited upon the latter. Upon a full consideration, then, of all that had been advanced in the discussion of his paper, he could not but repeat his opinion, that under the system of sewage management, which was as yet held out to us as probable, and with our present knowledge and experience of the use of liquid manures, a liberal distribution of the sewage on grass was the most promising means of attaining an economical result—and that, although the inhabitants must be charged for the removal on sanatory grounds, yet that they might demand that the cost should be lessened by a proper application of the sewage.

Professor Way begged to thank the Council of the Society of Arts for the opportunity thus afforded him of expressing his opinions on this very important subject, and also for the opportunity of which, owing to the lateness of the hour to which the discussion on the former occasion extended, he could not avail himself, of saying how much the agriculturists of this country, and those who devoted their attention to the science of agriculture—how much faith they placed upon the conclusions to which Mr. Lawes arrived. Everybody was acquainted with the great pains and trouble which Mr. Lawes and his able coadjutor Dr. Gilbert, had taken at Rothamstead, to establish the principles of agricultural science; and, therefore, it was with very great satisfaction that he heard the opinions of that gentleman on this subject. He should say also, from his own experiments on this subject, that there could now be no doubt as to the composition and value of sewage. Mr. Lawes had arrived at the same results which, by a different road, he (Professor Way) arrived at some two or three years ago—that was—in determining the value of the sewage by a direct reference to the composition of the excrements, and within a very trifle the results which he had arrived at agreed with those of Mr. Lawes. Mr. Lawes had found that 2 ounces of solid matter were daily ejected by each individual of the population—taking males and females and people of all ages and classes together; and that three and-a-half tenths of nitrogen were ejected in the same matter. He (Professor Way) found it to be $2\frac{1}{4}$ ounces as against Mr. Lawes' 2 ounces of solid matter and $\frac{38}{100}$ths of an ounce of nitrogen, which within a minute quantity, agreed with Mr. Lawes' results. He thought, therefore, the question of the average composition of sewage water was set at rest, and that so far the subject was exhausted; for when two persons came nearly to the same point by different routes, he thought it might be considered that they had arrived at truthful results. If, therefore, he agreed with the data of Mr. Lawes, he could not hesitate to agree also with the general conclusion as to the gross value of sewage water. He also agreed with Mr. Lawes, that solid manure could not be profitably made from sewage. He regretted to have to state an opinion of this kind, when adverse to the interests of the many persons engaged in trying to make solid manure from that source, but at the same time he thought it did not become any one whose opinion was of any weight at all, to allow people to go on with those schemes when their success was opposed to all knowledge and experience on the subject. He therefore said unhesitatingly that any existing plan for the production of solid manure from sewage water, would be a failure. He said this from a knowledge of the fact, that of the valuable matters contained in sewage water, nine-tenths exist in a liquid state, and these could not be separated by any known process of filtration, nor could they be precipitated by any substance which they had at present at command. They could not adopt any system of simple infiltration with sewage water for these purposes, because it would not filter unless previously treated. The method proposed by the use of lime, enabled it to be filtered to a certain extent, but it threw down little or nothing but what was in suspension, and the matters thrown down from solution were in so small proportion, that if they could filter without lime, they would get a more valuable product. That these plans were good in a sanitary point of view, by dispolluting water that was before offensive, and cleansing to a certain extent the water-courses, could not be denied, but at the same time it would not produce a profitable manure. The quantity of lime required to neutralise the carbonic acid of the sewage was very great, and this being mixed with the product so obtained, materially reduced its value. Again, if the solid substances were collectable without the use of lime, the manure would not even then pay. The carriage of a cheap manure was obviously the same as that of a dear manure. Guano, for which they were paying £10 a ton, they could take into the country at a cost of not more than ten per cent. of its value, but this same cost of carriage would amount to 100 per cent. on the value of a manure costing £1 per ton, and the farmer could not afford that. The tendency was very properly now to increase the value in a given quantity of manure. If it was £30 per ton so much the better, provided it contained the same value as could be supplied by £30 worth of other descriptions of manure. Taking it for granted, then, that sewage must be supplied in a liquid condition, there were two principles to be borne in mind. He had not the same pretensions as Mr. Lawes to speak of the practical application of such a subject, because a chemist could only state his opinion upon theoretical grounds. At the same time it was the bounden duty of the chemist to point out the object to which people should direct their attention; that was—what was the utmost limit of success that theory promised, and it was then for the engineer and practical agriculturist to come, as nearly as might be consistently with economy, to these results. There were, he had said, two essential principles to be considered in the application of sewage. One was that the proper place for its application was not necessarily or usually the land to which it naturally flowed. In nine cases out of ten these were heavy clay lands, which did not require sewage. If well drained they would be naturally rich lands, and if not drained sewage could not be applied to them. But the lands which required sewage were those high-lying, or comparatively high-lying, lands, in which there was a fair admixture of sand and gravel, which would take in the sewage and allow it to pass through. He did not mean to say any sandy soils, but lands of a medium character, which benefitted by manure of all kinds; and, therefore, he said that they should endeavour not to go to the natural outfall, but to produce an artificial outfall, if that could be done at a moderate and reasonable amount of expense. It was the proper plan to pursue, and in so doing a more extended area was obtained for the deposit of the sewage. It had been stated in the course of this discussion, and he had elsewhere been informed that the pumping of a quantity of 80,000 gallons of water could be done for a shilling, raising it 100 feet in height. This was stated in one of Mr. Chadwick's reports. Now, if every person consumed 25 gallons of water per day, that would amount to 9,000 gallons a year for each individual. If the urine and fæces of 10 people were put upon an acre of land, 80,000 gallons would represent that quantity. These 80,000 gallons would be raised to the higher level of 100 feet at the expense of one shilling, and if twice or thrice that quantity were allowed, 2s. or 3s. only would be the additional cost of manuring an acre of land at a high as compared with a low level. He, therefore, would say, let it be their object to seek the high-lying land. Then he would say again, a great and an increasingly acknowledged principle was, that they should manure the land and not the crop It was not necessary, even in the case of liquid manure, that the crop should be on the land when the manure was applied. He believed there was abundant practical experience to show, that liquid containing manuring qualities produced its effects twelve months after its application, although it might be supposed to have run through before the crop was put on. But they had independent evidence of that fact, and here he must be allowed to refer to his own investigations upon this subject. He had found that soils removed nearly every particle of manuring matter from solutions which were filtered through them, allowing the water to run away and leaving the fertilising properties in the soil, and this proved that liquid manure might be applied to the soil without fear of losing the fertilising substances which it contained, although no crop was on the land at the time, a view of the subject which tended very widely to enlarge the opportunities for the application of liquid sewage manure. It was not necessary to be applied to the crop on the land, but they might take advantage of any favourable opportunity that presented itself for putting the sewage on. It was not for him to say to what description of crops sewage could be most profitably applied. All he said was, they ought to apply it to the land, rather than to the crop when it was on the land. He thought at present that principle was not properly understood. He would say a few words as to the quantity to be applied per acre to land. He thought Mr. Lawes' estimate was excessive. He had said 10,000 tons of sewage ought to be applied per acre. This amounted to something like the excrement of 100 people; now if they made a calculation of the quantity of solid mattter which 10 people would supply, they would find this would amount to twice the value of a good dressing of manure—that was, 10 people would, in a year, produce the ammonia and other matter equal to the fertilising value of between 5 cwt. and 6 cwt. of guano. He believed that manure was more effective in a liquid than in a solid state; and if they put on, as Mr. Lawes suggested, manuring matter equal to two or three tons of guano per acre, it would be wasting manure and doing harm rather that good. He repeated, he thought Mr. Lawes' estimate of the quantity per acre was much too high, and he thought it was a duty to the agriculturists to show that the sewage of a town could be profitably applied to a much larger area.

Mr. T. Scott said, in moving the adjournment of this discussion on the previous evening, his object was not so much to propound any views of his own on the sewage question, as to afford some legitimate representatives of the rural interest, if he might so speak, a fair opportunity of stating the views they at present entertained on this very important matter; for up to the close of the late meeting, it appeared to him that the professional engineers and official sanatory and sewage commissioners had it all their own way. Much of this question must undoubtedly be left to the investigation and decision of those gentlemen, but not all, although some of them, as in the case of Mr. Chadwick, had devoted many valuable years of their lives to the consideration of the subject, and it could not be said of him as it was of Lord Palmerston when Home Secretary, "that, while his *mind* was in the London sewers his *heart* was on the Danube;" for the ex-commissioner of health appeared to dote upon those subterranean streams, and to be desirous of capping his reputation as an agriculturo-sanatory reformer by securing the embryo wealth they were thought to contain! Now what this wealth consisted of had been carefully ascertained by Professor Way, and amply illustrated by Mr. Lawes, and the result appeared to show that five-sixths of it was held in solution, and one-sixth in suspension. This also was the case of the Edinburgh sewage water, according to Professor Anderson's analysis, which, however, must be noted as much richer in the elements of fertility; and this analysis confirmed the results of Professor Way and Mr. Lawes' investigations, if any confirmation were required. Now, as there was no *absolute fixer* of ammonia and of the other valuable elements thus held in solution, enabling us to secure the above five-sixths of volatile matter in a solid or sedimentary state, and then letting the pure water go free, a pretty general unanimity of opinion was becoming prevalent in favour of appropriating the *whole sewage of London* to irrigation. When we saw the enormous cost of engineering works and material for *precipitation*, and the inferior article principally produced, namely, 60 per cent. of carbonate of lime, or chalk, this feeling was intelligibly accounted for. No one, however, had as yet ventured even to shadow forth a plan on which this theory was to be carried out in practice, and it, therefore, appeared premature to launch so much recrimination as had been done against those, the business of whose lives was *remunerative farming*, for not accepting that which had never yet been put within their reach. As a practical agriculturist, farming land mainly for profit, he differed with Mr. Lawes and with a similar sentiment contained in a letter he held in his hand from Mr. Telfer, of Ayr, as to the propriety of forcing crops up to a point at which they became injured; but he was quite willing to use manure up to the highest point at which it was profitable. He at the same time was ready to admit, and had good data for believing, that ten times the present expenditure of manure could be profitably employed, if it could be obtained in any shape at the standard price of pure super-phosphate of lime, or guano. As one who, along with Mr. Skirving, of Liverpool, used the first handful of guano brought to this country, and afterwards purchased it at £26 a ton, he thought he might venture to say this much from his own conviction of the value of genuine manure. Mr. Mechi said that sewage manure could be profitably applied to cereal crops; we had no precedent, however, for such a doubtful practice except on a very limited area of light soils in this country, or in the rice swamps of Italy, India, and America; in fact, the great desideratum in connexion with cereal crops here was how to *stiffen* and support the straw, not how to turn it into a weak aquatic reed. Just ask any farmer—he would not even stipulate for an intelligent farmer—but one possessed of only the ordinary instinct of his kind, if he would like to have the fall of rain over his wheat-fields throughout the year, doubled or quadrupled, and you would have a sound solution of the problem as to applying liquid manure to wheat crops generally. Few of us would like to miss Mr. Mechi's presence from these meetings, and from Tiptree farm at his annual gatherings, but if he persisted in the practice of applying liquid manure to grain crops, his legitimate field of operations was not Essex, with its 130 rainy days in the year, but Italy, with its 38 (see Capt. Baird Smith on Italian Irrigation), or even the arid sands of Sahara. In these countries it was a question of *irrigation and a crop*, or, *no irrigation and no crop.* This, however was seldom the case with us in this country, and it, therefore, appeared to him superfluous to adduce the case of Italy, and other countries, with their comparatively rainless climates and arid soils, and where no parallel circumstances existed. The nature and appropriation of the soil, too, was so entirely dissimilar, that he thought he should do best to confine his remarks to what existed, or was proposed to be carried out at home in connexion with sewage irrigation. The lowest estimate of the quantity of land required for the London sewage was made by Mr. Lawes, and amounted to 20,000 acres. He, at the same time, confirmed the all but universal opinion, that grass, either natural or artificial, was the only crop to which liquid manure could be profitably applied. Now, although London was surrounded by grass lands, he could not see that this 20,000 acres could practically be obtained out of a less area than 40,000 acres, or upwards of 60 square miles of land—being a larger area than that on which London stands; (and here, within parenthesis, he would say that the Italian irrigation was nearly always applied to land under alternate husbandry.) The first question that occurred was how this immense tract of land for irrigation was to be obtained; were the owners and occupiers voluntarily to combine to take the sewage, or were they to be compelled under an act of parliament? He confessed this staggered him. Again, if the sewage at the rate of 10,000 tons per acre, as proposed by Mr. Lawes, was thus concentrated on a single district, would not the nuisance created be greater than that now existing in the Thames? Surely, if we were to pay for its removal, we were not to have an equivalent elsewhere. Why, residential property for miles around would be depreciated in let-able and fee simple value, and its owners would indite the nuisance, as would all passers by, whether by road or rail—and who would answer for the consequences? Who would justify the scheme to the general public, who have no interest in getting cheap, bad milk near town, when they could by rail get better from a distance. It would be seen, by a letter he should presently read, that two eminent men, Dr. Sutherland and Professor Simpson, of Edinburgh, had reported against the fœtid irrigation of one of the newest water meadows near that city, and that medical men had condemned the milk. If, on the contrary, it was attempted to apportion out the sewage of London in driblets over a wider expanse of country, Mr. Lawes had shown that it would *not pay*, and the chairman had confirmed his calculations. When Mr. Chadwick said that it could be delivered at a distance of 10 or 15 miles from London, and 150 feet above the level of the discharging sewers, at 2½d. per ton, he surely never meant that it was to be spread over the land—which was the principal item of cost—at that rate; if so, many individual occupiers of light land could apply the sewage with advantage, but not even *then* at the rate of 10,000 tons an acre, as suggested by Mr. Lawes, which, at 2½d. per ton, would cost £104 3s. 4d. an acre. It could be used more sparingly, however, and no doubt with a profit to many crops. He had been in the habit, for 5 or 6 years, of sowing upwards of 100 acres of turnips annually with Chandler's liquid manure drill, using about three tons of water or 672 gallons per acre, with signal success; but he never could get it distributed at less than about 6s. per acre, nor did he expect to do so, though this was nearly ten times Mr. Chadwick's price. He agreed with Messrs. Chadwick and others, that Mr. Wicksteed's estimates of cost for trunk drains and pipes for irrigation, were extreme—as also his estimate of land required, and which might, to some extent, be accounted for by his being an advocate for solidifying the sewage ingredients. He had, therefore, taken the figures of those who preferred irrigation. Mr. Lawes valued the ingredients in the sewage of London at £774,525, and Mr. F. O. Ward calculated the water with which they were carried off, at 90 millions of tons. Now, if all this sewage was to be applied annually to 20,000 acres of land, we should have 100 inches deep over 60 square miles. Imagine such a putrid sea within sight of the largest and most condensed mass of human beings in Europe, and then say if such a thing was likely to be tolerated. Edinburgh, with its 600 acres, was bad enough in sultry weather, as he had personally experienced; but what was it to this! Then take the case of Edinburgh as to the effect on the animals fed on sewage grass. Mr. Stevenson, the author of the admirable prize essay on the Farming of the Lothians, lately published in the "Journal of the Royal Agricultural Society" wrote him:—"Since *pleuro-pneumonia* became so prevalent, the loss from this disease in the Edinburgh dairies exceeds all belief. During the first year or two, the veterinary surgeon was called in; but as cures were seldom effected, the butcher has taken his place. The loss has been so great that many cow-keepers have been ruined. It is rather suspicious and against the system of feeding with irrigated grass, that Mr. Telfer, at Cunning-park, has been losing an immense number of cows, and the ventilation of his cow-houses cannot be surpassed, and cleanliness is most scrupulously observed. It is quite understood here," (Edinburgh), "that the experiment at Myre-mill has been anything but profitable; and Mr.

Huxtable has, we believe, partly relinquished the practice. (Authority, Lavergne, the French agriculturist.)" Then as to the special case of Mr. Telfer, a gentleman wrote:—" So great a nuisance is Cunning-park that we have felt the most offensive smells near "Alloway Kirk," distant a mile and a half. We advised Mrs. Begg, Burns' sister, to indite him for a nuisance. This she declined doing; but we believe that other parties have been threatening a process of this kind." Another correspondent in Edinburgh, on whom he could rely, said:—" The meadows being very near the town (Edinburgh), and being irrigated so frequently as to produce three or four crops of very rank grass in the course of the season, were considered a very great nuisance by the inhabitants in this neighbourhood, and it was considered a great benefit to the city, generally, when the improvements connected with the Queen's drive, &c., led to the practice of *so* irrigating those nearest town, being done away with. In hot weather, and in certain winds, the smell from these fields was intolerable, and the grass had the thick, rank appearance of the grass of a crowded churchyard. The smell, and their insalubrity, affected the rents of the houses exposed to their influence. As to the effects of grass produced by them on the milk or meat of cattle fed with it, I can only say that the general impression on the part of the public was very much against such milk and meat." Another competent witness, and one who had assiduously laboured for the best interests of agriculture, Mr. William Wallace Fyfe, stated, in a letter to him:—" The Edinburgh cow-feeders compete for this foul produce of the irrigated meadows; but any one who has seen the interior of an Edinburgh cow-feeder's establishment (and I visited most of them during the prevalence of pleuro-pneumonia some years back), would not be astonished at his adopting anything artificial in his economy, which is all eminently abnormal." " It so happens that the parts of the meadows best adapted for this kind of irrigation are those least liable to exception. Much of it has been reclaimed from the sea, and has *not a human being living on it, or near it.* A still larger expanse has, perhaps, as many as *two houses* within its pale, and *very few near it*—and this is the only sort of solitude where it seems tolerable to introduce the foul-water irrigation. The Government, I may add, for the protection of Holyrood Palace, once questioned this right of foul-water irrigation (unsuccessfully) as injurious to health. The owners answered in behalf of 3,300 cows in Edinburgh, and 600 in Leith, mainly dependent on the meadows for subsistence, that the irrigation was absolutely necessary for the supply of milk and butter to the city." " A poor woman near where I lived had sent round her *fourteenth subscription list*, before I left Edinburgh, for *the death of her fourteenth cow*, and her supporters preferred setting her up in a greengrocer's stall to sanctioning a *fifteenth* death. What her mortality was on a small, that of many of those artificial feeders enjoyed at that time on a large scale." One more witness, and he had done; this was the agent for Scotland for the Agriculturist Insurance Company, which lost so much by insuring Edinburgh cows in 1845 and 1846, that they declined to insure this stock for several years; and, being himself an auditor of that company, he (Mr. Scott) had examined the books, and found the loss, out of 563 cows then insured, greater than in any other locality. Mr. M'Min wrote:—" I am decidedly of opinion that the grass raised on watered meadows around Edinburgh is hurtful to the cows fed upon it. Their constitution is so weakened that they cannot resist the effects of disease when attacked, and the result is, that the proportion of loss in Edinburgh cannot be less than 20 per cent. This loss cannot arise from the confinement in the town byres alone, but also from the food on which they are fed. The grass does not give flesh, but large quantities of thin bluish milk. When disease seizes the animals during the season in which they feed on grass from these meadows, *a day's illness reduces them to all but a skeleton.* From this, I would say it has a tendency to destroy the constitution of the cattle, unless mixed with food of a more substantial kind. I am as satisfied also that the milk cannot have the same good effects on those who use it, as milk from a country dairy. Shortly after I came to Edinburgh in 1849, and after I had carefully examined the state of the cows here, their housing, and manner of feeding, I would not use the milk in my family, but got a dairy opened, and had the milk brought by rail from the country. That dairy has succeeded very well, and *I understand that a good many of the principal medical gentlemen in town now use the milk there in preference to the other dairies.* This fact strengthens my opinion that town milk is not so good for use as country milk, where cows are fed on the common farm produce. I am not, however, aware whether it generates disease in those who use it, but I cannot see how milk drawn from unhealthy and unsound animals can be beneficially and safely used. In the summer season and in sultry weather the atmosphere around the meadows is far from pure. At every cutting of the grass the canals with which the meadows are intersected are opened or shut, as occasion serves, upon the cut portions. The sediment manures the root, and the damp land, when the canals are shut, being acted upon by the sun and air, renders the place unhealthy. *The Town Council has frequently discussed the matter*, but nothing has been done to remedy the evil as yet, although no doubt there will. The effluvia arising from the meadows was the cause of discussion and ground of complaint. Had I had time, I would have called upon the late Lord Provost, who took a great interest in this matter, and I doubt not he would have enabled me to lay before you such information as would have been of use. In the Transactions of the Highland and Agricultural Society for last year, we found Mr. John Barlow, W.S. Edinburgh, stating, " go into Edinburgh byres, and you immediately hear cattle cough, and the dairyman says, '*it is quite natural.*' When cattle first come in from the country they do not cough, but it comes on quite soon enough afterwards." These were the opinions of men in the east of Scotland. Now, he had one letter from a large rent-paying occupier on the Duke of Argyll's estate in the west, and with which he was familiar, having resided as his grace's agent upon it, and he stated that irrigation and house feeding were supposed to destroy the procreative powers of cattle, and added, " The irrigation works in Ayrshire are looked upon by practical farmers and good judges with great suspicion, *i.e.*, Messrs. Kennedy's and Telfer's. Mr. Ralston's is upon the gravitation principle, and is most admired, *and considered the most profitable.* Indeed, the others are considered to be the reverse, even though Mr. Telfer sells his milk at 6d. per Scotch pint; but no one can say, without seeing the honest balance-sheet." In justice, however, to Mr. Telfer, whose extensive and exact knowledge of the sciences of chemistry and physiology, and love of their pursuit, had, he had little doubt, been the main instigations to him to undertake his wonderful operations to illustrate " agricultural possibilities," at Cunning-park, and with the purest motives to instruct and not mislead—in justice to him, he (Mr. Scott) should read part of a letter to himself, dated the 14th inst. That gentleman said, " I have hurriedly read Mr. Lawes paper, delivered at the Society of Arts, and agree with him in what he says about the advantage of manuring up to the point at which the plant is injured in its growth. It is better to put a large *quantity* of manure on a small area, than a limited supply on a more extended surface, or, if you choose, better to waste manure than land. I have been acting on this view in the growth of Italian rye grass, and with most satisfactory results. I believe I could put the whole liquid of my 48 cows on one acre of Italian rye grass, not only without doing injury to the plant, but with a decidedly more profitable return than if applied to a larger area." It must not, however, from this be supposed that Mr. Telfer would be able to feed his 48 cows off the acre so manured, for he saw by a report of the Board of Health, that he had *always* been under the necessity of purchasing not only foreign cake, but home grown corn and hay to sustain his cattle under his present system. But even if this irrigating system were found to be desirable and remunerative, the cost of carrying it out, generally, would absorb more than all the surplus capital of the kingdom. Take the case of the Duke of Portland, and who could imitate it by sinking £39,000 on 300 acres. But this proof was entirely wanting up to the present time, and we had as yet no pecuniary inducement, and certainly no sanatory one, to adopt the system, and, after banishing the ague by drainage, to bring it back by pestilential irrigation! How to render town sewage available to agriculture, remained one of the most urgent, but he feared unsolved, economical problems of the day, and the offer of £1000 for its solution, by Mr. S. Brooks, of Manchester, remained unclaimed. But the discoveries that science had made during the last few years, left no man at liberty to dogmatise of the future. In the meantime, he would venture to suggest that a Commission of two first class practical agriculturists, aided by a competent chemist and a hydraulic engineer, might be sent to examine the sewage of continental towns to see how it was disposed of, and if used, to ascertain the results. Until something of this kind be done, we must, he thought, be content to obtain for agriculture from our cities only such solid matter as blood, and, in many cases, night soil, as we could intercept from the sewers, and which the Sanatory and Sewerage Commissioners might much facilitate; and, afterwards, we might intercept the sediment by an inexpensive process, which he purposed recommending to the notice of the Commissioners. Our present information led to the conclusions, 1st. That precipitation produced an inferior manure, and would not pay for preparing; 2nd. That open-drain, foul water irrigation would not be tolerated; 3rd. That underground pipe irrigation was unsuitable for either low or elevated *clay soils*, was doubtfully remunerative *on any*, impracticable on a large scale, and would create an indictable nuisance; 4th. Intercepted solids and settled sediment, inexpensively obtained, seemed, then, the only residue we could secure out of this mine of liquid wealth. It was a *scientific* mistake to suppose that this water, or any kind of manure containing by analysis, the elements of fertility required, was, *per se*, adapted to all soils; for in many cases we required to alter the mechanical texture of the soil by *bulk*—hence sewage as rich as that of Edinburgh, might injure a clay soil, whilst the poorest solid manure might produce a beneficial effect. In the stewartry of Kirkcudbright he had seen land where, after the stones had been gathered off the land, it became unmanageable and unproductive, and these had to be restored to their original bed. And in Kent, he had seen land, on Sir Percival Dyke's estate, where flints were obliged to be brought back, for the same reasons, after having been sold for road metal. So, after all, the bulk of Mr. Wicksteed's precipitated manure might constitute its chief value, and thus *practically* modify the theory of the analytic chemists. A few experiments would shortly prove this, and it was to be regretted that we had no national experimental farm where such experiments could be made, and reliable results obtained.

Mr. CAIRD considered the conclusion which the preceding speaker had arrived at, regarding the alleged unwholesomeness of grass produced by liquid manure, to be without adequate foundation. Pleuro-pneumonia affected cows fed in every way. It had, no doubt, been most virulent in towns where the stock were crowded together and the air was foul. But on farms he had seen it equally fatal, whether the stock were fed on artificial grass or natural grass. The great importance of this question was shown by the elaborate calculations of Mr. Lawes, that the excrementitious matter of the population of London, if all collected, would yield manure equivalent to the production of 600,000 quarters of wheat, which was equal to the whole wheat produce of Scotland. The ammonia would be equal to that yielded by 40,000 tons of guano, or one-fifth the annual importation of that substance, and worth upwards of £400,000. It seemed to be generally admitted that, with our present knowledge, it was impracticable to make a solid manure of high value from sewage, and the plan hinted at by Mr. Ward, of separating the valuable portion from the rain-water, might be open to the fatal objection of so rendering the small sewers detrimental to health. Any result of that kind would be infinitely more injurious than even the total waste of the sewage under the present system. The conclusion seemed to be that the sewage of London possessed no money value except as a liquid manure. He was not aware of any facts yet published which showed that value satisfactorily. The Report of the Board of Health, so far as he could recollect, gave many instances of the advantage of farm sewage, but not one of London sewage; and the case of Edinburgh was not in point, for that was a system of irrigation *en masse*, nor could that adduced by Mr. Morse, of Swaffham, (though a very valuable fact) be deemed conclusive as to London. If we took Professor Way's estimate of the solid and liquid excrements contained in London sewage, we found it to be 1 in 1,400. If that *one* was equal in quality to Peruvian guano, then 140 tons of sewage would supply as much manure as 2 cwt. of guano, with the water to wash it in besides. Now this quantity, at the price mentioned by Mr. Chadwick, 2d. per ton, costs almost exactly the same money as 2 cwt. of guano, viz., £1 3s. 4d. But the water itself was of very considerable value to a grass crop in the dry months of summer. In Ayrshire, Mr. Morton told us that the use of 100 tons of water an acre in washing in guano, was found to give two cuttings, instead of one when the same quantity of guano was applied dry. Was the *one* then in sewage equal in value to the same weight of guano? That was a point to be determined by analysis and actual trial. If it could be satisfactorily proved, there could not be a doubt of the agricultural benefit to be derived from London sewage so applied. Even should it be of somewhat less value, the water in which it floated might make up the difference. Mr. Pusey had shown the enormous produce his meadows in Berkshire yielded by the application of water alone. We all knew the value of a shower of rain in dry hot weather, and if we had the power of throwing on something better than rain when we liked, it would be well worth paying for. But it might no doubt be said, why not use the water which you would get for nothing on your farm instead of paying for it? He had no doubt that this might be done occasionally with great advantage in washing in guano to Italian rye grass, but it could not be done for nothing. In a trial which he had made with horses, water barrels, and tank, he found that to pump, carry out, and apply liquid at a distance of only 120 yards, cost 2½d. a ton. Now sewage, at 2d. a ton, must be cheaper, for if guano paid to be washed in with 100 tons of water, you had the cost of the guano—

	£	s.	d.
Two cwt. at 11s. 6d.	1	3	0
Cost of applying 100 tons of water by water-cart, at 2½d.	1	0	10
	£2	3	10
Against 140 tons of sewage at 2d.	1	3	4
Showing a saving by the use of sewage of	£1	0	6

Let it be proved then by actual experiment that the *one* of sewage was equal in its effects to guano, and there would be an abundant sale for it anywhere within 10 miles of London, provided you could deliver it from hydrants in the farmer's field at 2d. a ton. The position of the metropolis and other large towns was highly favourable to the use of this manure, for, within a circle of 10 miles, the land would be found to be chiefly under grass and market gardens, to both of which it might be applied with peculiar advantage. And when gentlemen spoke of the danger of using so large a quantity of liquid to crops, it was not considered that Italian rye grass under this system yielded five crops in a season, and could, therefore, absorb with advantage a much larger supply of liquid than a single corn crop. He thought the solution of the question now rested with the engineer. If the engineer could construct his works so as to deliver sewage in the farmers' fields for 2d. a ton, the point was gained. For even though the water had but a very small portion of actual manure, who would not, as he had already said, gladly pay for an abundant supply of water at certain seasons? An inch of rain in the end of May might save the hay crop, and at 2d. a ton this could then be had at a cost of 16s. 8d. The advantage of the water drill was well known in the south; now the timely application of a quarter of an inch of water, at a cost of 4s. 2d. an acre, might make the difference between success and failure in starting the turnip crop. But do not let them blame the stolidity of the farmers, as had been done by a speaker in the previous night's discussion, for any part of the failure of this system hitherto. It was quite a mistake to suppose that, as individuals, the farmers were averse to the introduction of improvements, or unable to comprehend their value, or to appreciate their own interests. Let the gentleman who thought them so simple try them by dealing with them. Look at the rapidity with which they adopted guano as a manure. In 1841 it was scarcely known. In 1845 nearly 300,000 tons, at a cost of two millions sterling, were used by the farmers of this country. Prove to them, as clearly as guano had proved itself, that you could give them a valuable manure for even less money, and you would have a demand larger than you could supply.

Mr. Mechi observed that allusion had been made to the effect the sewage treatment of the land had on the health of the cattle, and the bad quality of the food they produced. He wished to be allowed, from an experience of three years, to say that the milk produced was of the most nutritive quality—better than he could obtain in any other way. It was brought up to London for the use of his own children, and he was now supplying the child of a friend of his with it. The child might be seen in St. Paul's-churchyard, and the young mother had expressed her gratitude to him for it. The same remark applied to the quality of the butter, and the meat was most excellent. With regard to the health of his cattle he was happy to say that he had not lost a single animal in three years, notwithstanding their filthy pasture. His tank contained dead animals, and all the refuse from the house, and it was no uncommon thing for the cattle to be feeding on the pasture twenty-four hours after the application of the manure, and they had the result, in the shape of milk, in forty-eight hours. He thought they ought to form their judgment in some measure on facts like these; and he would venture to suggest that the Sewage Commissioners should be asked to make arrangements with farmers occupying four or five hundred acres of land for a constant supply of the sewage, to ensure its value being properly tested.

Mr. Haywood (Engineer to the City Commissioners of Sewers) thought they would be arguing upon wrong premises, and that it was likely to mislead agriculturists, if it was understood, from what had fallen from Mr. Chadwick, that sewage could be delivered on to land 25 miles distant from any point at 2½d. per ton. It was true, that in some cases water might be raised 100 ft., and delivered a distance of 10 or 15 miles for about 3d. a ton. But that was only delivered in bulk, and, whether for household supply or for agricultural purposes, it would only be on the edge of the estate or house, where it was to be used. Now it was the provision of the distributing apparatus, and the cost of distributing, which was the principal item of charge in irrigating land. In most of the pamphlets of the Board of Health, which were not remarkable for giving estimates at a very high figure, the cost of this distributing apparatus was from £1 10s. to £3 per acre, and the interest upon this had to be taken into account, and above all the current working expenses, if the pipeage would not distribute by itself, but require manual labour, and above all a large supply of hose. The cost of this hose would be found to be a large element in the cost of the distribution, and this fact appeared to him to have been kept much in the back-ground in the argument; the wear and tear of this hose was exceedingly great, and the charges for this indispensable article, in distribution, would go far to prevent the general application of the sewage water of the metropolis. In the Board of Health estimates canvas hose was generally taken, because the first cost was less than that of other hose; but that which was cheapest at first was not always the best. He had used, he believed, every species of hose that had yet been submitted to the public, and he had no hesitation in saying, that canvas hose was the worst kind there was. He had found it wear out much more quickly than any other. This was his experience in the use of hose in paved streets, not in agricultural operations. If this experience would apply in agricultural operations, it followed that the estimates given by the late Board of Health were of little value. With regard to Mr. Wicksteed's estimate of the cost of distributing the sewage water of the metropolis, which had been impugned, the data used by him in framing it should be held in mind. He had taken the figures of a late eminent agriculturist, (Mr. Smith, of Deanston,) who said that the quantity of town sewage water which, upon an average, could be applied, would be 150 tons per acre per annum. If that was an error, Mr. Wicksteed's calculations were so far wrong; and doubtless, if the sewage was diluted as it appeared to be, 150 tons of water would not convey to the land a sufficient quantity of fertilising matter. But how much water land could take would be a matter for practical agriculturists to determine. If it could take ten times that quantity, then Mr. Wicksteed's estimate could be reduced. Mr. Chadwick had, however, objected to Mr. Wicksteed's calculations, on the ground that the real sewage need not be mixed with so much water, and that by gaugings of the sewers 12 gallons per head per diem were shewn to be sufficient for all purposes; and all running off beyond that was waste; and that by it the sewage was diluted threefold. Now, this seemed to be holding out the idea that before long the same quantity of fertilising matter produced by the metropolitan population, might be reduced in quantity to about two-thirds of its present bulk. Now the valuable paper of Mr. Lawes had for its object to lead to the expression of some definite views with regard to the sewage of the metropolis as it was; and if it was essential that no chimerical views should hinder this, what was the probability of the sewage water being reduced in quantity, and of a given quantity of it conveying to the soil a larger quantity of manure than at present. The present supply of water was about 25 gallons per head per diem; and we were about to have the constant supply given to us. Now the experience of those towns where this mode of supply was most fully developed, showed a large increase over the present metropolitan consumption. At Glasgow it was more than 30 gallons per head per diem. According to latest returns from American towns, which were represented as models of water supply, it was more, thus—at Philadelphia it was 35 gallons; at Boston 53 gallons; and at New York 90 gallons per head per diem. With this before him, he did not anticipate the sewage of London would in future be much less diluted. He agreed that, by economical usage, 12 gallons per head per diem might really be sufficient; but he did not see how the inhabitants of London, when they had in every house a tap over a sink, and had the power of wasting water to any extent, could be kept to using that quantity. And when he considered that we were anticipating increased habits of cleanliness, when all persons were in the coming time to take their daily bath, like the Romans of old, (and, indeed, be somewhat cleaner than the Romans, for he believed that, although they bathed more, they washed their linen considerably less than the denizens of this metropolis) and they contemplated applying water as a mechanical aid, &c., he could not but think the consumption of water would increase until it reached the figure given by Mr. Wicksteed, of 35 gallons per head per diem, and the sewage would be more diluted than at present, and consequently of less value, for the value of most applications appeared to be in the ratio of the fertilising matter it held to its bulk. This, then, after all, was the sewage water which agriculturists would have to deal with, and in this light it should be discussed. But, then, it was also attempted to be shown that the sewage water was not so good as it might and would be, by stating that the sewers of London held back the valuable matter until it soaked away, or was evaporated,—the phrase was, the drains and sewers "formed one system of extended cesspools." This was a favourite phrase with some people—a former officer of a Commission of Sewers first used it, and it had been constantly repeated ever since, no pamphlet of the Board of Health ever appearing without reiterating it in some shape or another—and most of the evidence which had been given on sanitary subjects, he could not help saying, had been given by those who knew practically very little upon the subjects of which they spoke, and that statement of Mr. Chadwick's, as to the whole of the metropolitan sewers being a cesspool, was incorrect. He did not mean to deny that some sewers were bad enough to deserve that term, nor that some drains were not, or that there was not room for improvement in the sewerage, but it was incorrect as applied to the metropolitan sewers as a whole, and they were not in such a condition as to allow all the sewage either to be collected in them, or to ooze out through them, so as to leave what ran off of little value. This was proved by the fact that the quantity of water discharged from the sewers daily was about the same as the water daily consumed by the population. Instead of it being the tendency generally of water to escape to the surrounding earth, those who traversed sewers knew that the water from all sides found its way through into the sewers. Again, if there was deposit anywhere, it was of the more solid portions, and that was known to be of the least value, the best of the sewage being the supernatant water; so that the sewage water of the metropolis at present might perhaps be considered to be as rich as it was ever likely to be. Some evaporation of the valuable volatile portions might be reckoned upon in any system, so that chemical analysis of the human fæces would not altogether help them as to the practical value of sewage water as now constituted. As the irrigated meadows at Edinburgh had been most frequently quoted as an illustration of the profitable application of sewage water, it should be stated that the sewer itself, which was in fact a large stinking black ditch, ran right through the centre of some of these meadows; on the line of sewer was an undershot wheel, worked by the sewage water, which pumped up the water to the surrounding land, which was not above 30ft. in the highest point above the sewer; it would be seen how favourably these lands therefore, were situated, and how economically the water could be applied to it. Mr. Chadwick stated that a quarter of the sewage of Edinburgh was applied to these 600 acres of irrigated meadows. As the population of Edinburgh was, in 1851, 258,000, there was then the sewage matter of 107 persons applied per acre. To get the same quantity upon an acre of land, it would be necessary to apply annually between 4000 and 5000 tons of metropolitan sewage water as at present constituted, and infinitely more if the usage of water increased by the constant supply being given to the inhabitants. It was for agriculturists to determine whether any land could bear such an amount of water to be placed upon it, or whether it could be profitably applied. Again, they had been told that Mr. Johnson considered 33 acres of land would take the sewage of 1000 persons, but to put the excreta of 1000 persons upon the land, it would require about 1200 tons of metropolitan sewage, as at present diluted, to be thrown on to it; therefore, Mr. Johnson's experience with a more highly concentrated fluid, did not much help them as to the agricultural value of metropolitan sewage water. He thought it most probable that at all the places by which the value of this fluid manure was sought to be illustrated, the fluid used was far richer, and far more highly concentrated, and, therefore, more valuable, as requiring less cost for its distribution, and being far more adaptable, as being capable of dilution at pleasure. When these cases were compared with the sewage water of the metropolis, all the circumstances of locality, soil, strength of manure, facilities for its economical distribution, &c., should be taken into account, or they would only lead to results which would cause dissatisfaction. He did not wish it to be understood that he thought the sewage water of the metropolis valueless; his convictions were, that with the sewage applied as it was, some lands might yield wonderfully; that the application of mere water alone must, in many cases, be highly beneficial, and, indeed, the plant could only feed from liquid manure; that manures, when applied solid, must, therefore, be put into a comparative state of solution before they could be absorbed, and it had been conjectured with much reason that plants were fed by gaseous products slowly evolved from manures. But the fertilising agents in the London sewage were in a greater state of dilution than elsewhere, and with this fluid it was that agriculturists had to deal; and the disposal of this fluid as it was, not as they could wish it to be, was the question. Practical tests by competent and unprejudiced agriculturists could alone decide its value, and whether it would bring such profits from its application as would enable it to compete with the best manures of the day. If it did not do this it would, of course, be a failure. The cost of applying it was the real question. It was a very different thing, as regarded cost, to apply the sewage of a small town, with the country fit for its reception almost within the town, and to apply the sewage of the metropolis, most of which was produced at points miles distant from any lands fitted for its application; and not only that, but at such a level as would enhance the cost of its delivery at the point of its usage considerably. He feared greatly he should never, certainly not for a great many years to come, see more than a very small quantity of the metropolitan sewage so applied, and that, if the river was to be freed from its pollution, we must look to some other and more immediate means than the application of the sewage to the purposes of agriculture. He would just add one or two remarks upon what had fallen from Mr. Ward. He would not trespass upon their time by descanting upon the merits of pipe sewers, but would allude to the probability Mr. Ward held out of their being able to save the Thames from pollution, and increase the value of the sewage manure. Mr. Ward said he had propounded the principle, "The whole of the rainfall due to the river, the whole of the sewage due to the soil." He then told you that the question of sewage interception had been hitherto an unsolved problem, and it had baffled the skill of the most eminent engineers; and then (which was very satisfactory) he told the meeting he had solved the problem. Now Mr. Ward's solution of the difficulty, he understood, was by dispolluting the large surface water sewers, which were formerly, and still were, small tributary streams; so that they might discharge still into the river, and collecting the sewage by other channels, and discharging it whenever it was desirable. Now, most people would desire this, but in the metropolis he feared it could not be accomplished—the scheme involved double sets of sewers and house-drains. There were now about 1,000 miles of sewers in London, and 100,000 houses draining into them. The first thing to be done, then, would be to lay 1,000 miles of other sewers by the sides of those already existing, and 100,000 additional house-drains in the houses already having drains. He merely mentioned this, which was one, only, of the difficulties, and would not go further into it, as it was a subject which, doubtless, would soon be discussed in another arena. But on this point Mr. Ward apparently differed from Mr. Chadwick, who, in extolling the virtues of sewage water, alluded to its enrichment by soapsuds, street sweepings, soot, and those fertilizers which found their way into the sewers at times even of the least rain. By the separation proposed by Mr. Ward the Thames was still to be treated to this, whilst the sewage water was to be deprived of it. This matter, however, which had really little to do with the subject of the paper, he would not further allude to.

Mr. **Paine** said he would not have obtruded on the attention of the meeting had he not been invited by the secretary to offer some remarks upon the subject of Mr. Lawes' paper. He was simply an agriculturist, and knew nothing of London sewage excepting what he had gathered from the researches of others; but he was glad thus to have an opportunity of publicly thanking Mr. Lawes for the great benefits he had conferred on the agricultural interest, by his most careful investigations and experiments at Rothamstead, as well as for the information he had so liberally made known to all his co-operators in the art of farming. He, Mr. Paine, had had the gratifying privilege of frequently viewing those experiments, and had largely availed himself of the knowledge thus obtained from Mr. Lawes, by carrying out upon his own farm, on a tolerably extensive scale, those manuring principles which he had seen developed at Rothamstead, and, he was happy to add, with invariable success. To the conclusions of Mr. Lawes, that we must measure the value of manures by their chemical ingredients, he gave his most hearty assent —and he thought that the enunciation of the maxim, that we should chiefly estimate the worth of manures by reference to the proportions of nitrogen and phosphoric acid they might contain, to have been of immense service to all those farmers who had availed themselves of that information. Mr. Scott had just now alluded to the rank luxuriance of the Edinburgh meadows, as an instance of extravagant liquid manuring, and had attributed the disease so prevalent amongst the cattle fed on those meadows to the bad quality of their food; while Mr. Caird altogether dissented from this view on the ground that his own cattle, receiving a different kind of food, were quite as severely visited by the epidemic. But whether the rank quality of the grass in the Edinburgh meadows, predisposed the cattle fed thereon to the taking of this particular disease or not, still he (Mr. Paine) felt satisfied that even grass lands might be over-manured by too large doses of sewage, so as not to allow it time to form those chemical combinations with the soil which Professor Way had spoken of, and which he had good reason to believe, always took place in the land before the manure could be healthily assimilated by the plant, the manure being as it were digested by the soil, and thus fitted for vegetable use; and if so, it was highly probable that excessive manuring would produce a growth of crude vegetation of a poisonous rather than a nutritive character. But, returning to the uses of the London sewage, it had been generally admitted during this discussion that the several processes for converting it into a dry manure, were failures, on account of the low chemical value of their results. To the liquid form of application our attention was chiefly directed, but from the many practical difficulties which had been started, he (Mr. Paine) was not very hopeful of a speedy realisation of the advantages which the theory of the subject would lead us to expect. In the onset of any such undertaking, it seemed pretty clear that unless the City of London, for its own sanatory purposes, lent a strong helping hand to the agriculturist, there was not much prospect of so large a scheme being attempted; there must be, in fact, a combination of both interests. Now, as to the theoretical value of this London sewage, we learned from Mr. Lawes' Tables that each individual in the course of the year supplied about 8lbs. of nitrogen and 4½lbs. of phosphates, which substances would, if available, be worth at least 4s. and 3d. respectively; and, taking the population at 2,500,000, we had a money representation of £531,250 per annum. This was supposing there was no loss of nitrogen in respiration, but this loss would be more than compensated by other refuse matters which flowed into the sewers along with human excreta. Then, again, 80lbs. of nitrogen in the sewage, combined with the accompanying phosphates and alkalies, would be a most liberal manuring per acre for any description of crop: ten persons produced this quantity, consequently 250,000 acres ought to be manured. Such capabilities of manuring, and so large a money value, ought not, and we might be allowed to hope would not, be eventually lost. The chemist and the agriculturist recognised the value of this sewage, but they must look to the civil engineer for the means of application. Mr. Way told us, in the early part of the evening, that we were not to expect much advantage from the application of sewage to the low-lying alluvial lands near the Thames, as they could not be properly drained for this purpose; and he (Mr. Way) differed from the opinion of Mr. Lawes, and many others, in thinking that it might be advantageously used for cereal crops; and he stated that he had arrived at this conclusion from the facts which he had discovered in his investigation of the absorbent properties of soils, and, therefore, especially recommended the use of sewage *prior* to the crops being sown. He (Mr. Paine) would be able to adduce a few facts presently, illustrative and confirmatory of Mr. Way's views, which, he considered, had a most important bearing upon the useful application of liquid manure. He fully believed that the metropolitan sewage might be beneficially used as a manure to *every crop*, provided due regard were paid to the time and mode of distribution, and provided always that the land were, either naturally or artificially, drained, so as to ensure a porous subsoil. Upon grass land, and on Italian rye-grass, there was no difference of opinion—you had only to put on plenty of it. Mr. Mechi, too, had shown in his practice how much good liquid manure had done to his root crops, though, it appeared, he had not yet reached the *acmé* of perfection, since we had seen that Mr. Wilkins, on the poor sands of Wokingham, as much transcended Mr. Mechi as that gentleman had ordinary cultivators. He would say nothing of the profitableness of this underground scheme of irrigation, and merely mentioned it now, as what might become the germ of important consequences in the mode of applying liquid manure. For his own part he would fearlessly place the sewage upon the soil destined for root crops at any convenient time, *before* as well as after the plants came up. And here he could not but refer to Mr. Caird's valuable remark, that if sewage, or even water alone, could be obtained when wanted, at the prices stated by some of the speakers, it would prove a great boon in certain dry seasons in saving the crop of upland hay, and in starting the young root plants. Mr. Paine would now detail a few facts which had recently occurred on his own farm, which would tend to prove the soundness of Mr. Way's opinions relative to the possibility of successfully using liquid manure for corn crops, if placed upon the land at the proper time. 1. A field on a gravelly soil, resting upon chalk, was manured, in September 1853, with about 8,000 gallons of liquid per acre, from the farm-yard tank. It was sown, in the beginning of November, with Payne's "Defiance Wheat," the same sort that the Rev. S. Smith, of Lois Weedon, sowed in his experimental crop last year. It was a rather coarse variety. The rick being the produce of this field was threshed out in the autumn, the crop was 64½ bushels per acre, and was sold for £18 per load of 40 bushels. The crop of straw was fully 3 tons per acre. 2. Part of another large field of a similar geological character had been in Italian rye grass for three years previous to the spring of 1853, and during this period it had occasionally been liberally dressed with strong tank manure. It was sown, late in the spring of 1853, with wheat, and the whole field was much blighted. Last year, 1854, the field was sown with oats, and the part which had previously been manured with the liquid grew the strongest crop of oats he ever saw. The crop of the whole field was a good one; indeed, the average growth of oats on his farm was upwards of 13 quarters, but this portion of about three acres greatly surpassed any other. The straw stood fully six feet high. 3. Another instance was on hops, in a field adjoining another farm-yard, in which there were spots where the chalk subsoil was faulty near the surface, and which were naturally less fertile than the rest of the field. Upon these spots in the winter time, when of course there was no growth in the plant, the liquid from the manure tank was pumped. This happened during two successive winters, and the result was the bringing of these poorer spots of land to the average fertility of the whole garden. He, Mr. Paine, regarded these "facts from the fields" as highly confirmatory of his friend Professor Way's researches in the laboratory, and he could confidently recommend them to the attention of his brother farmers, and he hoped they might tend to lead others to make similar experiments, as it was manifest that the safe application of liquid manure to the cereal crops had a most important bearing on the sewage question. He would only add another word in conclusion. Some of his friends who had visited his farm, might ask him why he had partially discontinued the use of liquid manure. His answer was, that with the aid of Mr. Way he had discovered an inexhaustible supply of soluble silica on his estate. It was a porous rock, similar, in many respects, to charcoal, especially in its deodorising and absorbent characters. He, therefore, now ground this rock into powder, and the liquid manure from the tanks was absorbed by it. This enabled him to give all his root crops a moist seed bed of highly stimulating properties. It might seem curious that he thus fell back upon manures obtained by absorbtion, the making of which from sewage he deprecated at the commencement of his remarks. But, then, let it be remembered, that the manufactory was on the farm, and, therefore, the cost of carriage constituted a very trifling expense.

Mr. **Edward Wilkins** here directed attention to some specimens of crops of hemp and flax, also mangold wurzel and potatoes, which he said were grown upon land in Wokingham not worth half-a-crown an acre. Those specimens, he said, were the result of his method of applying air and liquid manure to the roots of the plants. A potato set in sand produced 84 potatoes, and a crop of peas under his treatment showed an increase of sixfold, whilst in the root crops the results were equally astonishing. He mentioned that he had patented a process for the disposal of town sewage in a way different from any which had hitherto been practised, and also for deodorising the sewage. He had communicated with the Metropolitan Commissioners of Sewers on the subject, and personally with Sir John Shelley, but he had received no answer from either quarter, and if, he said, people were treated by the authorities in that way, they could not expect to get much useful information conveyed to them. With reference to the use of solid manure, he would state that when he applied it to potatoes, he found the plant was attacked by the grub worm, from which the liquid manure was entirely free, and by the application of it in that form, he obtained a better crop.

Mr. **Bailey Denton** said, he was happy to express his concurrence in the opinion that agriculturists should be heard on this question, and although he was but a farmer to the extent of some 100 acres or so, and did not profess to be an agriculturist, yet he was much interested in agriculture professionally, and took especial interest in the matter before the meeting. He should tell them that the question of irrigation had become to him a question of great moment, from the situation he held as engineer to a company incorporated by Act of Parliament, allowing the cost of irrigation to be charged upon the inheritance of estates. In order to warrant the charge of the cost of works, like those which had been proposed for the application of town sewage by irrigation, as a permanent improvement of the land, he had taken considerable pains to inform himself upon the subject, and he must admit that he had come to conclusions very unsatisfactory with regard to it. He could not see that their present knowledge and experience would allow of its being profitably done. It was necessarily a matter of great importance with the Company whom he humbly took upon himself to represent on that occasion, to encourage, if practicable, the cause of irrigation, particularly in the application of sewage manure by any tried processes. He alluded particularly to the process advocated by Mr. Telfer, Mr. Mechi, Mr. Kennedy, and others, and he must confess he was far from satisfied that that process could ever be a profitable one. In order to charge the cost of applying liquid manure on the inheritance of land benefitted by it, it must be shown to be profitable, upon that doctrine which ought to govern the affairs of all men engaged in agriculture, viz., that they ought to have a larger annual profit than a bare interest upon the outlay. With this principle before him he had tried to prosecute that inquiry, and he had come to a most unsatisfactory conclusion upon it. Mr. Caird had said this was an engineering question, that if they could deliver the sewage water as ejected from the London sewers—not concentrated sewage manure—at 2d. per ton, it would be freely applied to the land. He (Mr. Denton) was not of that opinion. Mr. Haywood had most properly said that when it was delivered at 2d. per ton up to a certain point, it did not mean that it was delivered upon the farm at that price; it did not mean that it was supplied to the hydrants upon the farm, including the cost of the iron pipes and hose, and the cost of other means of mechanical appliance. No such thing! As he understood it, it was the delivery to a point adjacent to the farm or estate, or to a certain highway or byeway, and the landowner must apply it from thence. What more might be done, was a question yet to be solved. No one could for an instant doubt that sewage manure was valuable; but to be profitable it must be applied, and he had not yet seen nor had he yet heard of any means by which it could be profitably applied. Mr. Lawes, to whom they were very much indebted for his valuable paper, had said that it might be applied to 20,000 acres at the rate of 10,000 tons per acre. Did anyone know what that meant? Twenty-four inches fall per annum was the average rain-fall of the neighbourhood of London; but this meant, if he could read aright, 100 inches per annum, or four times the rain-fall! Could anything be more futile? He had visited Mr. Telfer's farm, and that of Mr. Mechi, and he had witnessed the application of liquid manure on the "Marcite" system at Edinburgh, and by various processes, but it seemed to him, that in the consideration of the subject all soils and all subsoils were viewed alike! A more fallacious proposition never was made! If he went to Mr. Telfer's farm, he found the soil to be sandy, and that, owing to this circumstance, it took in, and rapidly infiltered or discharged the water that it took in, thereby leaving, he presumed, in its passage through the soil, the fertilizing matter of that liquid for the benefit of vegetation. But what was the maximum amount that Mr. Telfer applied in a year?—and in this instance they had before them the case of the farmer who had succeeded best, and who had fed his forty cows to his forty acres,—and who, in his desire to economise every ounce of straw and liquidise every ounce of manure, housed his cows on cocoa-nut matting—why, they knew very well they were dealing with five inches of liquid, and that they were not dealing with a hundred! At each application of liquid manure he applied one-inch surface flooding. Now, what meant 100 inches application? What did it mean if applied to the London clay, in contradistinction to the sandy soils? If five inches was sufficient in the case of a soil where there was a quick discharge, how could they think of applying 100 inches per acre to a clay soil absorbent and retentive, and which of course must be, in a question of this sort, a most material element, for we must not forget that when the sewers were issuing their full quantities, in consequence of the rainfall being mixed, as proposed, with the sewage, the land itself was in a wet state, and least able to receive a liquid, particularly if it were of the character of the clay soil round London. Mr. Lawes had spoken of the application of liquid manure to grass lands. He (Mr. Denton) could readily understand if permanent grass was put against the rotation of crops to arable land, grass was the best vegetation to which to apply it. But he had himself taken some pains with experiments (with a view to espouse, if practically sound and profitable), the application of liquid manure by means of iron pipes; he had gone through a variety of experiments, and he only found that as he approached to that point where the liquid manure was perfectly unhealthy to the persons in the neighbourhood, did he come to a profitable application of it. He knew enough of farming to be able to say, that upon clay lands, even well-drained clay soils, they must apply the liquid manure in a very concentrated form to make it valuable at all. In undrained clay lands liquid manure was altogether valueless. He had gone through a series of careful experiments, putting on liquid manure, and increasing the quantity of fertilizing matter till he got to the maximum, and decreasing the water till he got to the minimum, and then he saw an effect; but when he compared these several applications to equal dressings of farm-yard manure applied to pasture land, he found that the straw of farm-yard manure gave encouragement to the growth of the grass, as arose in the operation called "Gurneyism." He found a greater growth under the influence of farm-yard manure than was the case with the application of liquid manure, unless of an obnoxious strength. He repeated, there was in the straw of farm-yard manure a warmth which encouraged the vegetation beneath it, whereas the occasional use of liquid manure chilled the land by the evaporation which followed. Passing, then, from grass land, he came to arable land. He was, himself, at present most undecided upon the question, whether it was possible profitably to apply liquid manure to arable land. He did not mean to say it would not ultimately be proved to be profitable; he hoped it would be, but at present they were not in the position to apply it profitably. He confessed that his opinions on this subject had been somewhat shaken by the testimony of Mr. Paine—a most valuable testimony certainly with regard to cereal crops, and it had somewhat taken him by surprise. From all that he had learned upon the subject he had formed an opinion that it was not valuable for cereal crops, and with due deference to the statement of Mr. Paine, he still thought it would be found so in the long run. With regard to root crops, he had some evidence that it was not profitable even as applied to them. He went to Mr. Telfer's farm last year, in consequence of what was stated by Mr. Caird at Mr. Mechi's gathering, and Mr. Telfer showed him a field of root crop, part of which had been irrigated and part not. He asked Mr. Telfer to point out which was which, but he was unable himself to do so, and he had to call his bailiff in order to distinguish between the two methods of treatment. Those were facts which a man like himself—prosecuting the application of science to practice, must ascertain with precision. Now came the question to what could they apply the liquid manure most profitably. Mr. Caird, Mr. Morton, and Mr. Telfer, spoke of rye-grass. No doubt Italian rye-grass would be benefitted by it; but where would be the advantage of so applying it, when every other crop rejected it as unproductive of profit? He put the question, because in his mind it involved the whole subject. He had yet to ascertain that a rotation crop would be benefitted. For example, let us take a four-course system—two straws, one pulse or seed, and one root crop. Two out of the four it would not touch, and they would have gone to all the expense for, possibly, two, probably only one, out of the four crops. Mr. Haywood had alluded to the expense of the pipes and hose, and that, no doubt, was a material item in the consideration of the question of maintenance, as well as cost. To recur, however, to the rye crop, about which so much has been said in praise, he begged to express his doubts as to the true economy of such exhausting and succulent crops, although he should, doubtless, be reminded by Mr. Mechi, as he was the other night, that a rump steak contained 75 per cent. of water and 25 per cent. only of nutritious matter. But that was to speak as though we were to forget to cook the steak before eating it—by which the quantity of water would, he presumed, be diminished. He submitted that the proper way to test the value of such succulent crops as Italian rye grass was not by ascertaining their bulk, for there were disadvantages attaching to so much waste as 75 per cent., when consumed, which could hardly be over estimated. For instance, if we regarded past experience, we should find that it was not healthy to animals consuming such crops to devour so much fluid when in a hungry state. Abernethy used a favourite saying, "that you should never eat and drink at the same time, but follow the instinct of animals, which leads them to eat at one time, and drink at another." By the use of Italian rye-grass the life of the animal was shortened for the advantage of milk, which that succulent grass provoked, and thus the doctor's precept was negatived. Again, consider the loss of time and labour attending the appropriation of such succulent vegetation. Were we not losing sight of the advantage of concentration? At this moment we were sending out to the army in the Crimea, concentrated food as a matter of economy, while with a view to utilize the sewage of London, we were advocating the growth of succulent grass, as food for animals, with a known waste of 75 per cent. of fluid. These points might appear irrelevant, but when the question of the general economy of liquid manure came to be fully considered, we should find that each would have a place in the minds of those who desired to test practically the permanent value of prevailing theories.

Mr. Caird wished to explain that his arguments had been based upon the supposition that a large quantity of sewage could be delivered at 2d. per ton, and he believed that Mr. Chadwick meant that it would be so delivered to different farms, in such a manner that the occupier would have nothing more to do than apply his hose for its distribution. With regard to what he had said of grass crops, there were five such in a season, and only one of corn; therefore it was that it was more advantageous and economical for grass than for corn.

Mr. J. W. Bazalgette (Engineer to the Metropolitan Commission of Sewers,) said that he could add but little to the very able statements which had already been made upon the chemical and agricultural portion of this question, and at that late hour of the evening he would only detain the meeting for a very short period. He had listened with great interest to the various opinions which had been expressed with regard to the conveyance and application of town sewage as a solid or liquid manure, and he entertained various doubts whether it would be found practicable to apply the whole of the London sewage to the surrounding lands in the form of liquid manure advantageously. Mr. Lawes had stated, in his very valuable paper, that the sewage of London contained about 10,000 tons of ammonia, which would be sufficient to manure 400,000 acres of corn land, and had assumed that this manure could be received in the form of irrigation upon 20,000 acres of land, or one-twentieth of the first estimate. This latter must, therefore, in Mr. Bazalgette's opinion be considerably under the mark. Mr. Sidney had shown that the Italian meadows, which were so advantageously laid out for irrigation, were not at all times in a condition to receive the liquid sewage, which would more frequently be the case in this climate; therefore it would become necessary either to duplicate the area to be irrigated by the London sewage, so that when one portion could not receive it, it might be turned upon another tract of land, or it must at such periods be turned into the river. Professor Way had shewn that the only lands to which liquid sewage could be advantageously applied, were high lands, with a porous soil. These considerations would, in his opinion, vastly increase the cost of distribution in a liquid form; and Mr. Wicksteed's estimate of the cost of distribution would, to a large extent, be realised. He (Mr. Bazalgette) had some time since visited the Stanley-bridge liquid sewage works, where engines had been erected and distributary pipes laid down to supply the market gardeners with liquid sewage; but he found that its distribution had been almost entirely abandoned, and that the company were manufacturing and selling the solid sewage manure. This was an experiment made near home, and one worth inquiring into, and he had hoped that some person present would have been enabled to inform them why it was that after they had gone to the expense of erecting engines and laying down distributary pipes, they had abandoned the application of the liquid sewage. The point, however, to which he more particularly desired to call the attention of the meeting was the consideration of this as a sanatory question, which was annually becoming one of more serious importance. In London there were at the present time about 100,000 houses, or one-third of the whole number, drained into the sewers, and the Metropolitan Commission of Sewers were now destroying cesspools and draining into the sewers at the rate of 20,000 houses per annum. If, then, the Thames was now polluted, it must, when all London was drained, become threefold worse than at present, and in this respect he differed from his friend Mr. Haywood, in supposing that the sewage would become more diluted; on the contrary, he believed that the increased quantity of sewage would at least keep pace with an improved water supply. Throughout this country sanatory reformers had, during the last few years, actively prosecuted the drainage of our provincial towns, but they had not at the same time sufficiently attended to this portion of the subject, so that whilst on the one hand they had removed the nuisances from their towns, they had on the other hand polluted their rivers and brooks. He considered that it was as much the duty of a sanatory board to defray the cost of deodorising the sewage, instead of polluting their streams, as it was to pay for the construction of the sewers. This part of sanatory reform had been too long neglected, and whilst for the last ten years persons had been discussing and waiting for the discovery of the most profitable mode of applying town sewage as a manure, little or nothing had been done, and sewage was becoming a serious evil. If every town which had been drained would at once adopt that mode of deodorising or disposing of its sewage, which appeared to them the most promising in a commercial point of view, this question would then be soon practically solved. Much valuable information had already been obtained, as was proved by Mr. Lawes' paper and the discussion upon it, but unless some such course as above suggested, be adopted, we should, some five or six years hence, find ourselves at this or some other scientific society, discussing various opinions as to the best mode of distributing sewage manure, whilst our rivers and brooks would have become more unwholesome and polluted than ever. Mr. Wicksteed and the town of Leicester had at least, in this respect, set us a good example, and whilst he (Mr. Bazalgette) offered no opinion as to the value of the manure there manufactured, or whether it would pay a profit, or even defray the cost of its own manufacture, it would at least demonstrate that the sewage of a large town could be rendered inoffensive. The question of a cost and profit to that town must now soon be known, and he submitted that Mr. Wicksteed deserved our thanks for the prominent position which he had taken in this respect, and it was to be hoped that the time would ere long arrive when every town in England would profitably apply its manure in a liquid or solid form, but at any rate render it harmless and inoffensive.

Dr. Thomas Littleton said that, owing to the advanced hour, and as other gentlemen might still wish to address the meeting, his observations would necessarily be brief. This question was, as Professor Way very properly remarked, a compound one—sanatory and agricultural. That gentleman had said (*vide* "Royal Agricultural Journal," No. XXXIII., p. 167)—"The policy of towns, their primary concern, should be to effect the sanatory objects thoroughly, looking to the manure as a set off, greater or less." That gentleman made objections, similar to those of Mr. Lawes, regarding the different plans which had been propounded for securing the valuable constituents present in sewage, viz., that they failed to secure the ammonia which it contained, the greater proportion—nine-tenths—of which was discharged into the air, as in Mr. Wicksteed's process, or otherwise lost, being carried away in the large amount of water used. If this ammonia, and the other volatile compounds—sulphuretted hydrogen and carbonic acid gas—could be advantageously dealt with, the result mainly to be desired would be secured, so far as a sanatory point of view was concerned. The amount of these gases evolved into the atmosphere of London was calculated by one authority as equal to the enormous volume of 10,290,320 cubic feet annually—upwards of three-fourths of which emanated from an evaporating surface in the sewers, equal in extent to 145½ acres ("Hopley on Respiration," p. 58). If this evaporating surface were connected at different points with a vacuum apparatus, the draught thus created would enable us to collect these gases, which now become diffused in the atmosphere, within a small compass, and thus readily to deal with them, sulphuric acid being used to absorb the ammonia. A vacuum process, to be available, must fulfil the following conditions:—It must be one cheaply obtained—such could be had, in one form, ready at hand, by an outfall of water of 34 feet. The amount of the water at present supplied to London, under a pressure very much exceeding the column of water required, might thus be made to effect the chief amount of the exhaustion; so that but a small addition of mechanical power would be needed to attain all that was required. And, further, it must have a twofold connection established with it—one with the liquid contents of the sewer, by pipes having bell-shaped openings; another with the air in the sewer for occasions when the temperature of the atmosphere became unusually high, and the gases were evolved in greatly increased quantities; and at such times the air should be made to pass through a chamber containing charcoal. He then exhibited a specimen of the salt, sulphate of ammonia, obtained in the manner proposed, from an aqueous solution of ammonia, containing four per cent. of real ammonia; the temperature at the time of the experiment was 45° (Fahr.). In four hours the whole of the sulphuric acid, a fluid half drachm, of specific gravity 1·804, was converted into the salt here presented, under a small bell jar about 60 cubic inches in its content, by one exhaustion. The amount of the ammoniacal solution operated on was such as would render neutral to test paper the half drachm of sulphuric acid. He begged to call attention to the rapidity with which this was effected; and, further, that in several other experiments he had found that, by maintaining the vacuum for a period of 24 hours, every particle of ammonia was given off, the remaining liquid ceasing to give any indication of an alkali, with reddened litmus paper. The just inference from which was, that *however dilute* the solution of ammonia was, it might be entirely exhausted in this manner. He would only add that no correspondingly increased advantage was obtained by a degree of exhaustion beyond that of one-third of an atmosphere.

Mr. Wren Hoskyns assured the Society that he had attended these two interesting meetings merely as a listener, and found himself unexpectedly called on, and little able to advance the question beyond the point it had reached. He confessed that, from the general testimony that had been elicited in the course of the debate, from practical and scientific speakers, both as to the precise value and the engineering availability to the agriculturist, of sewage manure, the hopes he had always encouraged upon the subject had received less confirmation than the fears he had latterly been led to admit. Still, the problem appeared to him not without hope. And the ground upon which he founded it was this: That the problem had *two* heads to work it, two sets of shoulders to bear it—the agriculturist at the one end, and the sanatory commissioner on the other, both equally and interestedly bent upon its solution. "Nothing will ever be undertaken," says the poet Imlac to Rasselas, "if all difficulties must be first overcome." He felt an instinctive assurance that this subject would not end with this night's discussion; the question was too important, and the parties interested in it too many, to forbid the belief that further knowledge and research would be brought to bear on it, and further opportunity of its discussion afforded at some future day. He would admit that his mind was not unprepared altogether for the low estimate which chemical analysis had conclusively disclosed in the case of sewage manure. There were, it seemed to him, *reasons* calculated to mislead a judgment formed merely from the *physical senses*, as to the fertilising value of this manure. For obvious reasons no animal consumed so little food, in proportion to the living bulk, as man, whilst in no animals were the resulting organised tissues so important and *expensive*, physiologically speaking. Four pounds of new blood in the 24 hours (the quantity produced from the food of a healthy man), was a heavy *draw* upon less, on an average, than a pound of meat, with the relative proportion of farinaceous and vegetable food; and though from this, of course, a considerable residuum passed off in excretion, still, after due allowance for respiration and perspiration, the aggregate loss in the formation of new tissue, suggested *à priori*, ground for somewhat disappointing results in the agricultural value of the manure. In illustration of this, Mr. Hoskyns referred to some recent experiments at the Hatton Lunatic Asylum, in Warwickshire, the sewage of which, when distributed over the surrounding soil, under local circumstances peculiarly favourable for the experiment, seemed to have produced results in no degree commensurate with the anticipations based upon the amount of the nuisance experienced prior to its utilisation upon the soil. As he believed he was the last speaker upon the chairman's list, Mr. Hoskyns begged to be allowed to conclude this most interesting and instructive debate by proposing a hearty vote of thanks, on the part of the Society, to Colonel Challoner, for his most able and courteous occupation of the chair during this and their former meeting.

Mr. Higgs trusted that before the vote of thanks to the Chairman was put, he might be allowed to make a few observations. The subject before them was one of great importance, and ten years since he was the first person to propose to collect the sewage for manure in its solid form. Much had been said about Mr. Wicksteed's method, but that method belonged to him (Mr. Higgs), he having patented it ten years since, and expended a large amount of money, and a great portion of his life in bringing it to bear. Much had been said in depreciation of the value of this sewage, but he would ask them why should they confine their estimate of its value to its contents of excrementitious matter. Was not the refuse of slaughter-houses and many factories poured down to it in large quantities. Mr. Lawes had alluded to calculations made upon data, through the report of Mr. Herapath, on the value of sewage from Cardiff gaol. But they must recollect that that only contained the excrementitious matter of prisoners employed in sedentary manufactures, under a diet peculiarly low. Certainly, he had not seen what that dietary was of later years, but formerly it only consisted of meat once a year, namely, at Christmas, the remainder of the year the dietary being confined to gruel, bread, and potatoes. This showed how incorrect any comparison must be between the sewage of Cardiff gaol and the general sewage of London. He knew from experience and comparison that the sewage at Puddle-dock contained upwards of 40 per cent. of matter. Mr. Lawes spoke of bringing the chemical constituents of manure together, as though they could be so amalgamated as by the natural process; and he said, "such then are the constituents which it may be calculated would be contained in one ton of Mr. Wicksteed's sewage manure." Supposing that you could get these constituents together, would they be of the same value for manure as when elaborated through the processes of nature? He further said, "I find one and three-quarter cwts. of Peruvian guano would supply all the nitrogen or ammonia and the phosphoric acid of such a sewage manure; three or four cwts. of rotted straw would supply all its organic matter, and the residue I could obtain from the chalk and sand pits. Thus, for about 25s., I could bring upon my land the constituents of a ton of this manure, and for 30s. less money." As well might Mr. Lawes tell them that they could obtain all they wanted from the water flowing in the gutters of London. He called their attention to this fact, more particularly because he defied them, by any chemical amalgamation, to produce those results to be obtained from natural sewage. It was impossible by synthesis to obtain such results, whilst by a precipitation of lime by carbonic acid they would have 69 $\frac{8}{10}$ths of chalk and manure. He had seen in Wales, at Epsom, and other places, the results of this system, and he had no doubt that ultimately the agricultural world would admit the value of solid sewage manure. Happily, he would say, that ere long the case must be relieved of all doubt. At Nottingham the Board of Health had had patriotism enough to agree to assist them, by which the sewage would be collected for distribution on the land, and he trusted it would prove profitable to the agriculturists, and satisfactory to the sanatory reformers.

The Chairman said at that late hour he was sure it would be most agreeable to the feelings of the meeting that he should compress his remarks into as small a compass as he could. With the exception of the gentleman who had spoken last, the impression upon his (the chairman's) mind was, and of the greater proportion of those who had addressed them—backed both with science and practice—was that the attempt to get a solid manure from sewage, appeared to be almost impracticable—that was, impracticable at a profit, for it was of no use to do it without it could be done at a profit. Mr. Caird had given them some valuable experience on his own part, a good deal of which agreed with the theory they had heard from other quarters, viz., that the application of water alone to crops, particularly on light soils, was in itself remunerative and amply repaid the cost; and in that opinion he believed Mr. Mechi agreed. Then they had another most valuable piece of information from Mr. Haywood, who said, this was all very well, but what was the cost of delivery; and he very properly put the question, whether the cost of delivery at 2d. per ton, was to carry it to the roadside, or to one corner of the estate, or whether it was that amount over the whole of their property, which materially altered the cost at which it could be applied upon the farm. Mr. Paine, than whom from his large experience, no one was more qualified to give an opinion, had brought a very strong point before them in stating, that not only had this liquid manure been of advantage on grass lands, but he had shown them that it had been advantageously applied to his other crops, and that was a very material point. As far as he (the chairman) was concerned, he could in some degree confirm the statement of Mr. Paine in that respect, inasmuch as for the last five or six years he had been in the habit of sending tank water in a water cart upon his lighter corn land, and particularly he had done so with great advantage a month or two before putting in his root crops. Mr.

Denton on the other hand, had said it was of no use at all, that it was absurd to put water only upon the land in that way, but he thought the difference of opinion in this respect between Mr. Denton and Mr. Paine, lay somewhat in this—Mr. Denton's remarks applied more to clay soils, and he agreed that it was very little use in that case, as far as his own experience went. He believed Mr. Paine was right, and no doubt Mr. Denton was also right, because with what little experience he had had with clay soils, he had not found the same advantage as upon the sandy soils. Then Mr. Wren Hoskyns had given them the fact of a lunatic asylum situated upon a hill, so that they could get the sewage round the hill with great advantage sanatorily, but agriculturally speaking, with little advantage, inasmuch as the crop did not pay for the smell that was created. That was the plain English of the matter. He had asked Mr. Hoskyns what the soil was, and he said it was retentive—moderately retentive, but probably the surface had not been broken.

Mr. WREN HOSKYNS said the land had been ploughed.

The CHAIRMAN—At all events it seemed to have gone off in evaporation into the air. He would conclude by thanking those gentlemen who had brought to bear both practice and science in informing their brethren upon this subject, and he thought discussions of this kind would ultimately bring them to a right conclusion upon it at last.

Mr. PAINE having seconded the vote of thanks to the chairman for his conduct in the chair, the motion was put to the meeting, and carried by acclamation.

The CHAIRMAN having returned thanks, the meeting separated.

The Secretary announced that the paper to be read on Wednesday, the 28th inst., was "The Utilisation of the Molten Mineral Products of Smelting Furnaces," by Dr. William H. Smith, of Philadelphia, U.S.

The Secretary has been favoured with the following communication from Mr. J. C. Morton, who was unable to attend the discussion.—

ITALIAN RYE-GRASS AND TOWN-SEWAGE.

SIR,—To those interested in the discussion which has lately been conducted before the Society of Arts on the value of town-sewage as manure, it will be satisfactory to learn that the London Farmers' Club—a body whose opinion will be received with respect by the agriculturists of this country—adopted at their last monthly meeting a resolution affirming the profitableness of those enormous dressings of dilute liquid manure, by which those large growths of Italian rye-grass are obtained, that have given such celebrity to a few farms in the neighbourhood of Ayr. What those growths are, may be gathered from the fact, that on the produce of 35 Scotch acres of young Italian rye-grass, and of 35 Scotch acres of one-year old Italian rye-grass, Mr. Kennedy, of Myre-mill, keeps a herd of 250 large cattle, 25 horses, 450 sheep, and from 180 to 200 pigs, for five months of the year. The cattle and the horses are large, the sheep are small, the pigs are of all ages. Their daily consumption may average one cwt. a piece for the first, and 16 lbs. daily for the others; their total consumption throughout this period, therefore, must amount to nearly 3,000 tons, which is an enormous produce of grass from 70 Scotch—84 imperial—acres of land. This produce appears in Mr. Telfer's case, in the fact that from 7 Scotch acres, at Cunning-park, near Ayr, he obtains enough grass in this way for 48 cattle during 5½ months of the year, that extent yielding, according to his calculation, about 270 tons of green food. This produce appears still further remarkable in an instance where it was actually weighed. Mr. Kennedy told me that, on the 21st of April last year, a field of sixteen Scotch acres of Italian rye-grass was begun, and on each day subsequently a perch was measured, and its produce weighed, and the weight of the first cutting per acre, calculated by a perch weight, ascertained each day, was 16 tons; a second cutting, ascertained in like manner, was 25 tons; and a third was 17½ tons; and the fourth, in September, was 16 tons; and after this a foot high of grass was eaten down by sheep, which, if it had been cut, would have weighed 8 or 10 tons per acre. Here, then, was a produce of 74 tons per Scotch acre in a year.

These growths of grass are obtained by heavy manuring. Mr. Telfer, after each cutting of Italian rye-grass applied between three and four cwts. of mixed Peruvian guano and sulphate of ammonia per acre, and by his system of underground pipes, fixed hydrants, and moveable hose and jet, he then floods the land with one inch thick, or 100 tons per acre of liquid manure. This is chiefly water, but it contains, distributed through it, such a proportion as belong to the time since the last application, of all the solid and liquid excrements of the cattle fed upon this grass.

The liquid manure is all applied on the grass during the summer, and on the land intended for corn and root crops during the winter.

It is, I think, in the success which attends the application of it to Italian rye-grass that Mr. Telfer and Mr. Kennedy's experience with it has a bearing on the town sewage question. If it be profitable for the former of these gentlemen to make butter, on produce thus obtained, 400 miles from the market where it is sold, it is, I think, possible that a method of applying town sewage in the cultivation of the same grass, close by this market, may yet be devised which shall reimburse the outlay. As to the quality of the dairy produce from grass thus grown, I can only say that Mr. Telfer's butter sells at the highest price obtained in London, and finds its way to the tables of West-end consumers; and as to the health of the animals, *that* is insured by attention to ventilation and to cleanliness, their food being kept at the requisite degree of moisture by attention to the age at which it is cut.

No doubt farm sewage is a very much more dilute manure than Mr. Telfer's 3 cwts. of guano are, even though they are washed into the land by 100 tons of water,—but heavier dressings of the former must be used in some degree to compensate for this deficiency in quality, and if it should find its way on to the land, it is to fertilize simply by its own weight, and without the use of artificial force; these heavier dressings might, I should think, be applied cheaply enough to ensure a profitable result.

It all depends, however, I believe, upon this "if,"—for however efficient for soil this dilute sewage is, and therefore however profitable an expenditure incurred in its removal as a nuisance, its power for good—its value *per ton* as a manure—is so very small, that the smallest possible expenditure incurred in providing against the loss of it *may* be unprofitable.

I am sir, yours respectfully,
JOHN C. MORTON.

Farmers' Club, Blackfriars.

Home Correspondence.

THE DISCUSSION ON THE WATER SUPPLY.

SIR,—My attention has been called to a letter from Mr. John Evans, that appeared in your Journal of the 16th February last; to a letter from Mr. Homersham in your Journal of the 23rd Feb. last, and to another letter from Mr. John Evans, in your Journal of the 9th inst.; all referring to the gauge used by Messrs. Dickinson and Co., at Apsley Mills, near Hemel Hempsted, Herts.

The drawing, showing the sectional elevation of the gauge, which appeared in your Journal of the 23rd Feb. last, was made in 1842 under my directions, and accurately represents the gauge made by me for Messrs. Dickinson and Co. in 1835, and as it existed from that time till the year 1849, when I left the service of Messrs. Dickenson and Co. I may state, also, that I have every reason to believe that the gauge was not altered in any way until after the Bill of the London (Watford) Spring Water Company was before the Committee of the House of Commons, in 1852. I have heard that after this time, the gauge was taken down, examined, and found to be so decayed, that a new gauge was made to replace it; but I am not acquainted with the particulars of the gauge after the sitting of the Committee in 1852.

The gauge as stated by Mr. Homersham, was filled by myself, with my own hands; the mould, peat, gravel, and chalk, were put in the gauge exactly as shown in the section; the thickness of the layer of each was taken from a pencil sketch, made at the time of filling the guage, and kept by me ever since.

For several years after the gauge was first made I registered the amount of water that passed through it, if any did; no vessel was placed to catch any water that might come from the overflow pipe, and no means were taken to know if any water passed through it or not.

I may state, that for nine or ten years after the gauge was made, Mr. Evans never saw the gauge, and, therefore, he should not be so positive in his statements.

With respect to the amount of water raised at Messrs. Dickinson's Mills from the borings sunk into the chalk by Mr. Paten, I may mention that the statements made in Mr. Homersham's letter were given on my authority, and are as correct as possible. I may also state, that the amount of water raised from the borings is in proportion to the quantity of water required for the manufacture of the paper, and that from experiments I have made on the amount of water yielded by three of these borings, I am satisfied that double or treble the quantity of water actually raised could be procured from the borings, if wanted.

The water from the borings is infinitely superior in quality to the water from the river Colne, and for this reason it is so useful for washing and mixing with the pulp in the making of paper.

I am, sir, your's obediently,
WILLIAM LONG TYERS.

18, Ann-street, Plumstead, March 10, 1855.

*** This letter was omitted last week owing to want of space. It must conclude the discussion on this subject.—Ed.

DECIMAL COINAGE.

Comparative View of the Different Systems.

Sir,—One great obstacle to the introduction of the decimal method of money reckoning, is the unsettled state of the public mind as to the best system to be adopted. It may, therefore, be useful to direct attention more particularly to a comparison of the rival systems.

1. I shall assume it as desirable that the new system shall be thoroughly decimal, not composed of a decimal and a non-decimal part; that there shall be two coins of account, the unit and its hundredth; that the lower coin of account must be nearly about the value of the present farthing; and that the new and old monies of account shall be as easily convertible into each other as may be.

2. It may be observed at once, that two of our present coins of account, the shilling and the penny, are unsuitable as coins of account under a decimal system; because the $\frac{1}{10}$s. ($1\frac{1}{5}$d.) and the penny are too large for a lowest coin; and the tenth of either of these ($\frac{3}{25}$d. and $\frac{1}{10}$d.) are too small for the lowest coin. This may be disputed by those who do not consider that the farthing is about the right value for the smallest coin of account: at present, our previous practice and the general opinion seem to concur in recommending that our money scale should descend to near that value, but that it is unnecessary to carry it lower down. At all events, it is manifest that this ought to be a primary consideration in determining our new money of account; but it is often overlooked. It appears incumbent on those who advocate any material departure from our present lowest coin, to show that it is too large or too small, and that what they propose is more suitable in this important point.

3. The present silver and copper coins are decimally incompatible, so that one or other must be sacrificed. If we retain the silver coinage, we may preserve our present pound standard, or have the easiest possible transition to it (by 10); but it will be impossible to convert a less sum than 6d. exactly into the new coinage; in every such interchange, there must be a fraction of a farthing to be lost on one side or other, or to be made up in some other way.

4. On the other hand, if we retain the copper coinage at its present value, and decimalise upwards from the farthing, we have the advantage of being able to convert any sum in the old into the new coinage exactly, without any surplus of fractions to be lost or allowed for; but the relations of the new coins to our present standard, the pound, and to the shilling, become intricate, and the mutual conversion is tedious and troublesome.

5. It is very important to bear in mind (and it is often overlooked), *that the penny and the farthing are decimally incompatible*, so that if we decimalise from the penny, dividing it into tenths, ¼d. and ¾d. will be inconvertible into these tenths, and 1, 2, 3, 4, 6, 7, 8, and 9 of these tenths, will be inconvertible exactly into farthings.

6. It thus appears that whether we decimalise from the silver coinage or from the penny, there must be the inconvenience of inconvertibility to a certain extent; and that the complete convertibility of the old and new coins is to be attained only by decimalising upwards from the farthing.

7. These seem to be the general considerations by which the question between the silver and the copper coinage must be determined; but to judge correctly on the subject, it is necessary to enter into more detail as to the advantages and disadvantages on either side; the materials for this more exact comparison will be found in the following tables and rules, showing the numerical relations of our present leading coins with both decimal systems.

8. The first table exhibits the *florin* as the basis; practically the same as the *pound* system; the florin being taken as the unit, that there may be only two coins of account, and only two figures of the less coin, which I have called a *cent*, meaning $\frac{1}{100}$ of a florin, being the same as the *mil* of the Parliamentary Committee.

£	s.	d.		Florins.		Cents.
1	0	0	equal to	10	or	1000
0	1	0	"	$\frac{1}{2}$	"	50
0	0	6	"	$\frac{1}{4}$	"	25
0	0	1	"	$\frac{1}{24}$	"	$4\frac{1}{6}$
0	0	$0\frac{1}{4}$	"	$\frac{1}{96}$	"	$1\frac{1}{24}$

1 Fl.	equal to	£$\frac{1}{10}$	or	2s.	or	24d.	or	96f.
1 Ct.	"	£$\frac{1}{1000}$	"	$\frac{1}{50}$s.	"	$\frac{6}{25}$d.	"	$\frac{24}{25}$f.

9. The system shown in the next table is adapted to the copper coinage so as to ensure complete convertibility, the farthing being the basis, and a coin of the value of 100 farthings (2s. 1d.) the unit, which we may call a *half-dollar*.

£	s.	d.		Half-Dollar.		Farth.
1	0	0	equal to	$\frac{48}{5}$	or	960
0	1	0	"	$\frac{12}{25}$	"	48
0	0	6	"	$\frac{6}{25}$	"	24
0	0	1	"	$\frac{1}{25}$	"	4
0	0	$0\frac{1}{4}$	"	$\frac{1}{100}$	"	1

2s. 1d.	equal to	£$\frac{5}{48}$	or	$\frac{25}{12}$s.	or	25d.	or	100f.
0s. $0\frac{1}{4}$d	"	£$\frac{1}{960}$	or	$\frac{1}{48}$s.	or	$\frac{1}{4}$d.	or	1f.

These two systems are practically the same as the £1 and £1 0s. 10d. systems, £1 being 10 times the florin, and £1 0s. 10d. 10 times the 2s. 1d.

10. These appear to be the only two systems calculated to carry out the objects referred to in paragraph 1, and the contest will probably be finally between these two. But many others have been proposed, which it will be well to dispose of before comparing these.

11. Some have proposed the half-sovereign as unit, the shilling being thus retained as a coin of account, new coins of $1\frac{1}{5}$d., and $\frac{3}{25}$d. being introduced as the 10th and 100th of the shilling. But this is objectionable, as involving the trouble of multiplying or dividing by 2 in changing pounds to half-sovereigns, or *vice versa;* and in having its lowest coin, $\frac{3}{25}$d., smaller than is necessary, besides the objection on account of the want of complete convertibility; while, if $1\frac{1}{5}$d. be taken as the lowest coin, that would be too great. It is to be observed also, that there is no great end gained by having the shilling as a coin of account. It will be retained as a useful coin under the florin system; and florins and shillings will be mutually convertible by multiplying or dividing by 2, which will not be troublesome in this case, as there never will be more than 19 to divide, or 9 to multiply by 2, operations easily done mentally and almost instantaneously.

12. Another system, which has made some noise by the activity of its author, Mr. Theodore Rathbone, is that of the tenpenny piece and the penny. To this there appear many and insuperable objections. It is not decimal; to bring tenpences to pounds we must divide by 24, or, which is little less trouble, perform the operation described by Mr. Minasi, in p. 259 of No. 119 of the Journal. Either of these operations is nearly as troublesome as the present method of bringing farthings to pounds—dividing by 4, 12, and 20; so that it is difficult to see what object would be gained by the change if we keep to the pound; and if we give it up the transition is still very troublesome. Besides, it has both the inconvenience of inconvertibility, and of too small a lowest coin if we divide the penny into tenths; and the lowest coin is too large if we do not descend below the penny.

13. Then there is the 8s. 4d., or 100 pence system. But this also seems inadmissible, as the penny is too large for a lowest coin, while the $\frac{1}{10}$d. is too small and has the inconvenience of inconvertibility; also, the conversion of 8s. 4d. coins into pounds would be troublesome.

14. Another method is to take the halfpenny as the lowest coin of account, the leading coin or unit being the dollar (100 halfpence, or 4s. 2d.). But it is questionable if the halfpenny is sufficiently low in value for the smallest coin of account; the tenth of the halfpenny would be undoubtedly too small; and bringing dollars to pounds and shillings are troublesome operations. The dollar is $\frac{5}{24}$ of the pound, and $\frac{25}{6}$ of the shilling.

15. Thus, by the method of exhaustion, we arrive at the two systems of which tables are given above, as the only practicable plans for a new coinage arranged decimally, and have now to compare these. It must be observed that, in aiming to make the mutual conversion of the old and new money easy, our object is to enable ordinary arithmeticians to execute it with quickness and accuracy. This will be best ensured when few acts of computation and few figures are required—when the operation approaches, as near as may be, to the simple inspection and separation of figures.

16. To change any sum in the new coinage, on the florin (or pound) system to our present money is an easy and almost instantaneous operation, except with sums under 6d. The fourth figure, and all to the left of it, are pounds; the third figure doubled gives shillings; the two right-hand figures are cents, of which 50 give a shilling, or every 25, 6d., and for any number less than 25 take one farthing less than the number of cents. Thus, to find the value of 236 fl. 70 cents, the fourth and fifth figures taken as pounds, give £23; the third figure doubled gives 12s., 50 cents give 1s., and 20 cents give 19 farthings or $4\frac{3}{4}$d.—in all £23 13s. $4\frac{3}{4}$d. This is within less than one farthing of the exact value. If the exact value is required, subtract the number of surplus cents (less than 25) from 25, the remainder will give the number of 25ths of a farthing—thus, 20 from 25 leaves 5; accordingly 20 cents are worth exactly $4\frac{3}{4}$d. and $\frac{5}{25}$ of a farthing. Changing the old coinage into the new, is also a simple process, the reverse of that just given. The pounds will occupy the fourth place, and those to the left; the shillings, divided by 2, give the florins, to be put in the third place; for an odd shilling take 50 cents; for 6d., 25 cents; and for less than 6d. take as many cents, and as many 24ths of a cent as there are farthings. The latter can be disregarded, if thought proper. Thus, £437 17s. $7\frac{3}{4}$d. becomes in the new coinage 4378 fl. 82 cents, and $\frac{7}{24}$ cent, which is obtained in a moment, as follows:—the £437 give the same figures in the fourth, fifth, and sixth places; the 17s., divided by 2, give 8 florins, for the 3rd place with 1s. over, which gives 50 cents for the 1st and 2nd places; 6d. gives 25 cents; $1\frac{3}{4}$d. gives as many cents as farthings, or 7 cents and as many 24ths of a cent, in all 82 $\frac{7}{24}$ cents.

17. Such are the easy and quick operations by which, on the pound system, the old and the new coinage would be mutually convertible with perfect accuracy for all sums of any number of sixpences; and within a farthing for a less sum than 6d. Some might prefer the usual arithmetical rule for the conversion of money into the decimal of a pound; but the above rules are equally expeditious and seem simpler for those not acquainted with decimal fractions.

18. On the other system, in which the farthing is taken as the lowest coin, and we decimalise upwards from it, the two right-hand figures are farthings, the 3rd. and others represent coins of 2s. 1d. each. To change any sum in a new coinage of this description to the old monies of account, the simplest method seems to be to view the whole as farthings, and divide by 4, 12, and 20; and conversely, to express our present money in such a decimal system, reduce it to farthings by multiplying by 20, 12, and 4: the two right-hand figures will be farthings, the others, coins of 2s. 1d. Thus, 227·23 or 227 half-dollars, 23 farthings, will be £23 13s. $4\frac{3}{4}$d.*

19. Each of these two systems may be considered as meeting the three first requirements mentioned in par. 1. They are thoroughly decimal, of two coins of account, and the lower coin is, in one, $\frac{1}{4}$d., in the other $\frac{24}{25}$ of $\frac{1}{4}$d. It is in their relations to the existing coinage that they differ. One is more easily convertible into the existing gold and silver coinage; the other into the existing copper coinage. The dealings of the poor man are greatly in copper, those of the richer classes in silver and gold. Hence it has been thought to be a question of the convenience of the rich *versus* that of the poor. But it is very doubtful indeed if this is a correct view of the case.

20. With respect to this question, the poorer or humbler orders may be divided into two classes; those who buy and sell and must keep accounts, either in books or in their heads, and those who receive daily or weekly wages, and have no occasion for any reckonings beyond a few shillings of wages or a few pence for the small quantities in which they make their purchases for their own consumption.

21. There is a very large class of poor, ill-educated persons, engaged in trade, who make a scanty living by means of small profits on considerable quantities of goods passing through their hands; the pound and shilling columns are the important columns to them; the pound is their standard of value, the ultimate form to which they bring their cash transactions—the measure of value to which they have been accustomed—the test of the result

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* If the dollar (4s. 2d.) were taken as the unit, then the whole must be taken to express halfpence, which would be brought to our present money by dividing by 2, 12, and 20, (or 12 and 40); and conversely, from £ s. d. to halfpence, by multiplying by 20, 12, and 2, the two right-hand figures being halfpence, the 3rd and others, dollars.

of their operations. That very numerous and useful class of small dealers would be greatly incommoded by any new system of money-reckoning that did not harmonise with the pound sterling; and for their sakes alone, to say nothing of tradesmen and merchants with more extensive dealings, it seems important that the decimal system to be adopted should rest upon the pound as a basis, or bear some very simple relation to it.

22. The poor of the other class live from hand to mouth, seldom see or possess a pound, keep no accounts, and use largely the copper coinage. It is chiefly for the benefit of these that the outcry about "the poor man's penny" has been raised. No doubt it would be a convenience to that class were the copper coins retained of their present value. But their very poverty would sharpen their intelligence, and make them learn very quickly the value of the new coins or altered value of the old ones; the vast educational power now in the country would instruct their children in less than a fortnight; simple tables would show them at a glance the comparative values of the old and new coins; 25 cents for 6d., and any number of farthings being equal to a trifle more than the same number of cents, would prevent them being materially wrong in any case; and the competition among dealers, which now adjusts prices fairly to the varying value of commodities, would soon fairly adjust the quantities of the latter to the changed value of the small coins. These considerations, it appears to me, render it perfectly unnecessary to take into account any little and short-lived inconvenience that this class may suffer from the change.

23. Much has been said about the inconvenience of a change in those public rates that have been fixed at a penny, or a certain number of pennies, as the stamp for newspapers or receipts, the postage stamp, tolls, &c. This difficulty has been very much exaggerated; there are many ways of adjusting it, as by a discount for a number, charging 5 cents ($1\frac{1}{5}$d.) for the receipt stamp, 4 cents, ($\frac{24}{25}$d.) for the postage stamp, &c., not quite so easy, of course, as if the same coin at the same value were retained, but still so simple and manageable, that it is surprising that any such difficulty should have been brought forward at all.

24. If, then, we determine the question by the convenience of that very large class, of both rich and poor, that have to keep accounts, the decision must be in favour of the pound system; and that not only because the *pound* is preserved, but on account of the simple relation it bears to the *shilling*, which, next to the pound, is the great measure of value; wages, and the prices of so many commodities being usually expressed in shillings. For the reasons already assigned (pars. 2 and 5), the much lauded penny cannot be used as a coin of account; and a tedious operation, involving many figures, and very apt to cause errors, is required to show us the number of pence, shillings, and pounds in any sum expressed on the farthing system. Every convenience, save one of secondary importance, is in favour of the pound.

I am, sir,
Yours, &c.,
H. REID.

March 5, 1855.

PROFESSOR WILSON'S PAPER, AND THE DISCUSSION ON THE IRON INDUSTRY OF THE UNITED STATES.

Sir,—I have read with considerable interest, the paper on this subject in your last number and the ensuing discussion, especially the part which refers to producing wrought-iron direct from the ore. It is well-known that my late father, in a very early stage of his career, directed attention to this subject; he more than once produced specimens at the meetings of the British Association. and at the period of his decease had been engaged in more complete experiments as to its practical realisation. In treating the hæmatites of the North of England, and indeed generally, he found that a great defect in the produce arose from interlamination of earthy matter, which, in the absence of the fusion of the blast furnace, remained attached and tended to exfoliate the bars; and the great loss by oxidation experienced in balling up the deoxidated material, proved a serious drawback to economical success. But preliminary difficulties quite as serious were surmounted, by perseverance and skill, at the commencement of the modes of manufacture now prevailing. The arrangement described by Dr. Percy seems extremely suited to prevent such undue waste, and it also appears, that Mr. Renton's process is about to be tested in Wales. But though I have no doubt that, by experiment and moderate outlay, excellent iron may be produced from properly selected ores, and even profitably for some purposes, it remains extremely improbable if this mode of manufacture will become general, much less supersede the existing modes by fusion and subsequent de-carbonisation, in which such a vast plant and capital are embarked. The spirit of the age promotes *quantity* of production far more than *quality*, as well illustrated by various speakers in reference to railway iron. The blast furnace is suitable for the reduction of every kind of ore, either separately or in mixture, and the immense convenience of such a process is not likely to be generally superseded by a means, to whatever perfection it may be brought, which needs more careful manipulation and exclusive selection. Details requiring much nicety do not soon find general favour. They demand peculiar intelligence in the manager, and give extra trouble with the workmen. The best railway iron in Wales is, I believe, from the works of the Messrs. Hill, of Plymouth, and it is manufactured by the aid of a patent process of my father's (now expired,) in which pure hæmatite is introduced to the puddling furnace; thus by a double decomposition metallising the oxide with the carbon of the pig iron. But Mr. Anthony Hill has long been distinguished for his attainments in scientific metallurgy, and it is by his skill that the process has been worked to a perfection which ordinary managers would not be, and have not been, at the pains to realise, even though a vast economy as well as improved quality is the result. I am, therefore, less sanguine than Professor Wilson on the introduction of a new process, requiring the rare and difficult union of practice and science. Indeed, an invention likely to change our present establishments would have to overwhelm them, rather by a proportionate increase in obtaining quantity. It was thus that the puddling process, by the facility it afforded of manufacturing on an enlarged scale, displaced the previous method with its superior quality, while even this last feature, when an especial object, is amply obtained by judicious care in the later method. The clay ironstones contain too much earthy matter for treatment by direct deoxidation, and the similar enormous deposits now discovered in the oolitic group, will tend still further to retard in this country any recurrence to the primitive manufacture of blooms without fusion. As to the importation of ores from America, I concur in thinking that event is at a still greater distance. There are magnetic ores of great richness in this country, which remain unworked, solely because there is a sufficient supply without them, though it certainly may be added, in favour of Mr. Renton's or some other such process, that protoxides of iron possess properties not so favourable to the reducing action of the blast furnace as the ordinary peroxides, and especially when used in mixture with them. As to the ten per cent. in imported weight by absence of water which it is alleged would be gained over the ordinary hæmatites, this is not entirely correct. The hematites of Ulverstone and Whitehaven, which form the principal supply, are not chemically combined with water; they are mere peroxides, combined with twelve to fifteen per cent. of earthy matter, principally silex, with traces of sulphur. The English hydrates are the hæmatitic ores of the Forest of Dean, and of the southern basset of the Welsh carboniferous limestone at the gorge of the Taff Valley. They contain above eight per cent. of water, without a trace of sulphur, and an appreciable quantity of potash and soda. Such hydrates are peculiarly suited for deoxidation, assuming a porosity by the discharge of the watery constituent, which facilitates the entrance of the carbonic oxide, now generally understood to be the agent which removes the oxygen, and imparts carbon during reduction. The alkali is likewise favourable to the elimination of the earthy alloys, and it was from such ores that my father obtained the most successful results of a perfect malleable iron direct from the ore, convertible into steel equal to the best Swedish. But no quantity of compact ore could be raised for the scale of manufacture.

I see reference in the discussion to an alleged new discovery, which has been circulated with much sensation. I can hardly account for the error, except from the unfortunate habit, which has long prevailed in mining publications, of falling upon incorrect intelligence. The iron ore of the Brenden Hills, in Somersetshire, is by no means the novelty now represented. It is twenty years, at least, since the late Sir T. Lethbridge supplied this ore from the old workings scattered over the hill, to the Victoria Works, in Monmouthshire; since which numerous parties have either leased or treated for leases of the veins. In 1846 I myself had 100 tons of the ore smelted at my works in the Forest of Dean. It was a massive red ore or hæmatite (so called), extremely dense, principally protoxide of iron, with six to eight per cent. of earthy matter, lime, silex, and alumina in nearly equal proportions, and something less than one per cent. of sulphur. Used in mixture I cannot positively assert the quality of the product, but incline to judge it hard and refractory. To demonstrate this "spathose," *i.e.*, sparry ore, is quite a misnomer. But the novelty is this:—there are three veins indicated by the old workings; my ore was from the most northerly. Early in 1849 I inspected an adit being driven on the south slope of the hill, by a lessee from Sir Thomas, to meet the southern vein. In 1851 I was informed the vein was struck, and, instead of cutting the dense red ore, similar to the fragments seen at the cross-workings (which at this point is unusually wide), a deposit was intersected of what the Cornishmen term white carbonate, yielding about thirty per cent of iron, with traces of copper. Surely, such a vein, about four feet average width, intermittent with dead ground, and to be wrought by deep mining, is very inappropriately brought into comparison with the enormous deposits of Northamptonshire, where the ore, royalty and every charge included, is loaded on the canals at less than 2s. per ton! It is not this "spathic ore," but the dense red ore, which will serve the purpose of the ironmasters over the channel. Excepting the specular protoxide of Buckfastleigh, it is, indeed, the richest English ore I have ever seen, the masses yielding 72 per cent. of iron, and with a liberal outlay a good deal of this may be raised, provided the veins do not *metamorphose* into the "*spathic ore.*" Pockets of rich ore, a few feet thick, embedded in soft watery slate, with considerable intervals of dead ground, do not, however, present the mining facilities afforded by the caverns or chasms of ore in the hard carboniferous limestone. In fact, I was much discouraged, in the end of 1849, on inspecting the results of a deeper adit of Sir T. Lethbridge's, on the north side of the hill, brought up by a water-wheel, a few yards below the pocket which produced the above 100 tons of rich ore. As to "novelty," Mr. Blackwell, and others, in 1849, sank trial-pits for the red ore, under advice (I was told) of Sir H. De la Beche. In 1852 some hundred tons of the lean "spathic" were shipped to Wales, but could not obtain a price that was remunerative. Much or little, rich or poor, the ore would, undoubtedly, be carried more economically to the shipping port by a railway, and such a means of carrying up lime for all the Exmoor district would be more beneficial to the land. The distance to the mines from Watchet is just that from Balaclava to Sebastopol, and the elevation of ground twice as high; but I do not see why this useful event should be promoted by startling both the old and new worlds with a geological announcement that is incorrect.

Of all situations where a good process, such as Renton's, or any other for producing malleable iron by direct deoxidation, would be invaluable, I should point out the works of the East India Iron Company, on the Malabar Coast. Here the material, the celebrated wootz ore, is already pulverised;—it is an iron sand, from which every particle of earthy matter can be easily removed by mechanical means. Does it not appear a great anomaly to subject such a pure protoxide to the process of the British blast furnace, devised and perfected especially for extracting a minority of metal from a majority of earths in our clay ironstones? For cast-iron the blast furnace must, of course, be employed; but to make wrought iron by first carbonising, and then decarbonising such a material, seems, surely, a circuitous and mistaken process. No attention whatever has been given to perfecting the primitive process of ironmaking, by applying to them the lights of increased skill and science. They have been merely superseded by circumstances. A new class of materials—pit-coal and ironstone—have dictated a new mode of treatment, very much by rule of thumb, for it has been by very slow degrees that any scientific principle has been able to find its way into practice. To import a child of circumstances to circumstances entirely opposite, is scarcely scientific in a sound sense. The knowledge but so lately acquired of the nature and action of carbonic oxide gas opens a vast field for intelligent improvements upon the early and then entirely empirical process of ironmaking. The furnace described by Dr. Percy seems to coincide with some plans of my own for employing carbonic oxide to prevent waste in balling the deoxidated ore, and I should recommend it to the earnest attention of those who possess the suitable material. I am, sir,

Your obedient servant,
DAVID MUSHET.

London, March 8th, 1855.

Sir,—May I request insertion for a few remarks upon the letters which appeared in the *Society's Journal* of last week, in reference to my recent paper on the "Iron Industry of the United States." The principal part which I wish to notice, in Mr. W. B. Adams's lengthened communication, is that in which he *mis-quotes* my statement explanatory of the increased cost of English pig-iron in the United States, and then, basing his own calculations upon this *error*, complains that "the statement is not clear." If instead of 20 shillings, he reads 20 dollars as the price at New York, I think his calculations will come out the same as those given. In the sentence following, also, I must differ from him. He says, "if it be practicable to pay freight for American ores *from* New York, as Mr. Wilson intimates, as ballast, English pigs can also go as ballast *to* New York." I think this is a *sequitur* that but few persons will be inclined to admit, especially those at all acquainted with the export trade of the two countries. The questions of labour, wages, climate, can probably be revived, if desirable, after Dr. Smith's paper on the 28th. They cannot be discussed satisfactorily in this Journal.

In my paper I avoided giving more statistics than were necessary for the objects which I wished to bring more particularly before the Society, from a desire to reduce the time occupied by it, and thus allow more for the discussion. I regret that Mr. Simmonds has not made his contribution more complete; at the same time I ought to mention that the Census returns are open to some doubt, as in the iron returns for the states of New York and Pennsylvania, furnished respectively by the state and by the Ironmasters' Convention, a very considerable difference is exhibited, amounting in the one case to about 23 per cent., and in the other to 40 per cent.

In another branch of production which I had to investigate, I was led to draw the same conclusion. The discussion hardly took the turn I wished, inasmuch as the really *practical parts* were barely touched upon, most of the speakers contenting themselves with discussing the *political* instead of the *industrial economics* of the subject, and with defending our ironmasters from a charge which at the utmost could only be an *inference* from what I said in speaking of the readiness of the Americans to adopt new processes to economise labour and to utilise waste products.

I am, &c.,
JOHN WILSON.

Iver, March 20th, 1855.

THE SMOKE NUISANCE.

Sir,—Mr. Muir's elaborate reply, in your Journal of the 2nd instant, to my brief remarks of the 29th of January, does not meet the main point at issue by any narration of *facts;* although his "*opinions*" are repeated in the tone of one who expects to have his individual *dicta* accepted as that of an unquestionable authority.

It is very easy for Mr. Muir to say, where the boiler capacity and fire surface are in due proportion, and the other local conditions are good, that proper attention by the fireman will enable him to prevent the formation of smoke as well *without* as *with* a smoke preventing apparatus; but if that statement be based upon actual demonstration, he certainly ought to furnish the particulars; and until he submits such *data* to examination—until he proves what he has affirmed—relying on my own practical proofs to the contrary, I shall maintain a decided negative to his conclusions.

After so long a lapse of time, it had no doubt escaped Mr. Muir's recollection, that the fireman at Messrs. Miller, Ravenhill, and Salkeld's works, explained (apparently to his satisfaction) the accident (not inattention) which caused the emission of smoke on our entering the premises. But even adopting Mr. Muir's version of the matter, his influence in my disfavour, in the single case adduced out of examination of my system, which he says occupied two "forenoons," is amply covered by the more enduring satisfaction of the eminent engineering firm referred to, who have since then had the remaining steam-engine furnaces at Glasshouse-fields fitted in the same manner as the first, and to whom I am indebted for many recommendations to their neighbours and other friends.

Mr. Muir, referring to my affirmative observations, says "I did not omit all mention of my experience as inspector at Glasgow;" but he fails to point out a single passage, either in the paper he read to the Society or the discussion which followed, wherein any such mention can be found. His reference to "Juckes' furnace" carried with it no such interpretation. On the contrary, it rather conveyed the impression that he was then acting as an agent for Juckes' furnaces.

With respect to the relative opinions of Mr. Fairbairn and Mr. Muir, I am bound to admit that the new evidence produced by the latter is essentially and materially in his favour; and Mr. Muir may well be pleased at an approximation to his own ideas, on some points, by a gentleman of such high attainments, practical and scientific, notwithstanding the difference that *still* remains between them as to the best legal means of suppressing the smoke nuisance.

And unshaken in my preference to practical experience over theory and imperfect exposition,

I am, sir,
Yours very truly,
J. LEE STEVENS.

1, Fish-street hill, City, 14th March, 1855.

Sir,—I am afraid that a prolonged discussion on the Smoke Nuisance will not be very acceptable to your readers, for the understanding of the subject requires an acquaintance with the construction and action of manufacturers' furnaces, which the public generally have not the means of acquiring. This discussion is the more irksome because, really and truly, the matter at issue is not of the very slightest practical importance. If smoke can be *prevented* from issuing into the atmosphere, it is not of the least consequence whether that result arise from preventing its formation, or burning it after it has been formed. The writings of Mr. Williams have given a mischievous currency to his peculiar notions, which, however theoretically correct, and distinguished from others, are, nevertheless, practically useless. Mr. Williams's review is a continuous sneer at my presumption in appearing as an instructor before so important a body as the Society of Arts. I might, sir, have been justly liable to some censure, if I had appeared after having spent the lengthened period of 20 years, which Mr. Williams has done, and made as little progress to a knowledge of the subject.

But, sir, let your readers remember that the points upon which I at first differed with Mr. Williams were but two, viz., 1st. the non-combustibility of smoke; and 2nd, the alleged *necessity* for admitting air to the interior of the furnace above the fuel, not in one volume, but in *numerous films or jets.*

Let it be observed also, that in his long review, Mr. Williams does not notice the second head of difference, I imagine for the very simple reason, that the evidence of Mr. Houldsworth, which I quoted at large, (and to which Mr. Houldsworth has since informed me he adheres,) was quite conclusive proof, that it is not only *not necessary* to admit the air in films or jets, but that it makes little practical difference how or where it be admitted, provided only that the requisite *quantity* be admitted. There remains, then, but the solitary question of the combustibility or incombustibility of what is called *smoke*, Mr. Williams contending that it is incombustible, while I consider that the term "Smoke Combustion" is correct, both *practically and scientifically.* Now, it may save confusion if I here explain what I mean by a thing being combustible. By that term I understand the property of being decomposable, the decomposition being accompanied by the production of light or heat, and in this sense smoke is combustible. Mr. Williams, though in general he makes the broad assertion, that smoke once formed is incombustible, says in the second sentence of his treatise, new edition, "when smoke is once produced in a furnace or flue, it is as impossible to burn it or convert it to heating purposes, as it would be to convert the smoke issuing from the flame of a candle to the purposes of heat or light." Sometimes this unqualified and most incorrect assertion is guarded, (see page 235 of his treatise) as follows:—"we see, then, how palpably erroneous is the idea, that smoke, once formed, can be consumed *in the furnace in which it is generated.*" In his evidence before Mr. McKinnon's committee, Q. 1230, Mr. Williams says, "I consider the *combustion of smoke* where it is generated, to be a physical impossibility, because, if the oxygen is there it will be consumed; if the oxygen is not there smoke will be formed." I am quite willing to give Mr. Williams the benefit of this qualification, and yet undertake to prove him wrong; and to show beyond dispute that smoke may be formed, and afterwards burned in the furnace, or in the flues leading from the same furnace in which it has been generated.

Though not a disciple of Bentham's, I am accustomed to follow his excellent rule of always calling the same thing by the same name, and, generally speaking, I am quite content to apply the term usually employed to designate an object. Thus I am accustomed to call smoke, smoke; and gas, gas. Mr. Williams, however, says that is *not* smoke which the public call smoke—he says it is *gas*, not smoke. And then he will triumphantly turn round and say, *gas can be* burned, but *smoke cannot.* Let Mr. Williams call the thing by whatever name he pleases, it will remain the same thing still. He may try to change the term "smoke nuisance" to "gas nuisance," but if he does he will not be understood. If his analysis of smoke be correct, the term "carbon nuisance" would be the most appropriate; but what difference would that make, further than proving Mr. Williams to be utterly wrong when he asserts that smoke, viz., carbon, is incombustible? I confess I was puzzled when I began to study this question, but nothing puzzles me now except Mr. Williams' pertinacious adherence to his distinction without a difference. I know what smoke is, and, moreover, I know **how to burn it**, much better than any of Mr. Williams' high chemical authorities, who have no practical knowledge of the matter, could teach me. But even these very authorities either support my position, or confess their want of practical knowledge. What did Mr. Solly, of the Royal Institution, say, when examined before Mr. M'Kinnon's committee?

Q. 1741. "Do you think perfect combustion is likely to be produced better by admitting air entirely through the bars, or by admitting the air both under and above the bars?"—Answer. "That must depend upon the operations of the stoker, AND THE QUANTITY OF COALS. If the coals are very evenly and smoothly spread all over the surface of the bars, *you may have perfect combustion from the air entering through the bars;* but if you have the coals heaped on only at one particular part, you cannot completely burn by the air merely introduced through the bars—*it will entirely depend upon the stoker.*" Mr. Solly is quite right, and surely I am entitled to claim him as a witness in proof of my assertion, that even with a well-constructed furnace and adjuncts, *management is necessary.* With a good draft and a good stoker, smoke may be burned without the admission of air above the fuel. What does Mr. Faraday say?

Q. 2005. Is it the impure coal-gas evolved after the fresh charge of fuel which originates the smoke, when not properly supplied with air?—Answer. Partly. It is a very mixed question. When a fresh charge of coal is put upon the fire, a great quantity of evaporable matter, which would be called *impure coal-gas,* according to the language of the question, is produced; and as *that matter travels on in the heated flue,* if there be a sufficient supply of air, both the hydrogen and the carbon are entirely burnt. But if there be an insufficient supply of air the hydrogen is taken possession of first, and the carbon is set free in its black and solid form; and if that goes into the cold part of the chimney *before fresh air gets to it,* that carbon is so carried out into the atmosphere, and *is the smoke in question.*"

Now Mr. Faraday may be claimed as a witness to prove that the discharge of carbon in its black visible form into the atmosphere, depends upon its meeting with a fresh supply of air *on its way to the chimney after formation;* and thus his evidence may be accepted as proof against Mr. Williams' assertion, that "smoke once formed cannot be consumed in the same furnace where it is generated;" but he elsewhere confesses to a want of practical knowledge on the subject, for, in answer to Question 2015, "Can the consumption of smoke take place after it is formed, with a saving of fuel?" he says, "I have not practical experience enough to answer the question." But Mr. Williams' chief dependence is placed upon the certificate of Professor Brande. Now, I consider that gentleman's opinion is not worth much, because he frankly stated to Mr. M'Kinnon's committee that his experience was very small. Here are his own words in answer to Q. 1869—"I should beg leave to state to the committee *that my practical knowledge upon the subject is very limited,* and that I cannot put that at all in competition with the practical knowledge of the gentlemen who have been before you. With reference to the *theory* of combustion, if there are any points relating to it upon which the committee require any information which I can give them, it will probably be more within my scope."

I have before referred to the evidence of Dr. D. B. Reid. I shall finish my reference to *authorities* by another quotation from his evidence. In reply to question 2098, he says:—"Take an ordinary boiler, where you have, as is adverted to by other witnesses, no extraneous admission of air whatever, none but what comes through the furnace bars, none let in on the top, none admitted behind, none admitted at the side, but where you have a careful stoker, and where you have, in an especial degree, large fire room in proportion to the duty to be done, what is the effect in such a case? If a certain amount of air be permitted to enter, and the bars have a certain width or opening, air may be introduced (if the bars be not overloaded with fuel, which is a necessary position in this case,) in sufficient quantity to consume the actually produced cinders, and there may be introduced *enough also to pass by the cinders* (if they are sufficiently free and open) *to lay hold of the material above, that would otherwise appear ultimately as black smoke.*" Surely, sir, I am entitled to take Dr. Reid as an authority against Mr. Williams' assertion, that it is *necessary* to admit air above the fuel to consume the gases. The necessity truly depends (as Dr. Reid has correctly put it) upon the depth of fuel laid on the bars, that, in other words, is, on the careful *management* of the furnace. But, further, the appendix to the report of Mr. M'Kinnon's committee, contains a formal definition of smoke, carefully prepared by Dr. Reid. As my object is simply to aim at the truth, and not to support any preconceived theory, I will give the Doctor's definition, which your readers may compare with Mr. Williams's.

"BLACK SMOKE, *that nuisance to which the attention of the Committee is directed,* consists essentially of carbon separated by heat from coal or other substances, and is commonly mixed mechanically with carbonic acid gas, carbonic acid, and other matters mentioned in the following paragraphs:—

"1. If this smoke shall have been produced at a very high temperature, the carbon forms a very loose and powdery soot, comparatively free from other substances.

"2. The lower the temperature at which black soot is formed, the larger the amount of other substances with which it is mingled, among which the following may be more particularly mentioned.—Carbon, water, resin, oily and other inflammable products of various volatilities, ammonia, carbonate of ammonia.

"3. When the carbon, oils, resin, and water, are associated together in certain proportions, they constitute *tar.* Soft pitch is produced if the tar be so far heated that the water is expelled, and hard pitch, *i.e.,* resin blackened by the carbon when the oils are volatilised. A further heat resolves the pitch into permanent gases and carbon.

* * * * * *

"7. Black smoke is always *associated with* carburetted hydrogen gases, composed of carbon and hydrogen in various proportions. These may be mechanically blended with the oils and resins, but must be carefully disguished from them. They form, more especially when in a state of combustion, the inflammable matters that constitute flame—the luminousness of that flame being enriched by the amount of carbon and of oily and resinous matters associated with it."

I beg particular attention to the following; as I read it, it is decisive as to Dr. Reid's opinion that smoke may be produced in one part of the furnace and consumed at another.

"8. Smoke that contains much oily and resinous matter at one part of a furnace, may become in a great measure carbonaceous and gaseous at another."

I am no theorist, sir, but a plain, practical man, who entered on the examination of the smoke question with unbounded faith in patented apparatus, and have been driven from that faith by stubborn facts, showing their utter uselessness; and my practical experience enables me to distinguish between sound science and that which is falsely so called.

But, moreover, Mr. Williams has, in his own elaborate work proved conclusively that—whatever he may say or think—he is truly a smoke-burner. To go no further, look at diagram No. 41, page 95 of his treatise. There the coals are exhibited burning and evolving smoke upon the fire-bars, and behind the bars is shown his diffusion boxes supplying air for the combustion of the *smoke after it has been formed* out of the furnace into the flue. Mr. Williams' process is identical with that of some fifty other patents. He has very justly and effectively written of late against *re-inventions*; is he not aware that his own patent was but a re-invention? In the year 1828 a Mr. Gilbertson patented a mode of supplying air behind the bridge by means of a box, the upper part of which was formed so as to divide the air into thin films, for the purpose, as he says in his specification, of *diffusing* it.

That the great bulk of visible smoke (and we have nothing to do with that which is invisible) is formed from the fresh fuel being thrown upon the top of the incandescent, and not from flame insufficiently supplied with oxygen, as in the case of an oil lamp, is proved by the action of Juckes' furnace, where the flame produces no smoke, although no air is admitted into that furnace but through the bars among the fuel. Mr. Williams quotes the opinion of Mr. Newlands, of Liverpool; why, the last time I saw Mr. Newlands, and conversed with him on this very subject, he said, "the best plan of smoke burning that I know of is to have a boiler larger than is otherwise requisite." Mr. Newlands, is, however, no authority on smoke burning. If he were, how is it that the Liverpool Committee on Smoke Nuisance consult Mr. Fairbairn, and send deputations to Manchester, to get information about smoke nuisance prevention? Against the opinion of Mr. Newlands I will quote that of Mr. Bourne, who, as editor of the Artisan Club treatise on the Steam-engine, thus speaks of Mr. Williams' patent:—"Of all the smoke burning schemes that have been brought forward at this or any other epoch, there is none that has been ushered before the public with more noisy pretension than that of Mr. C. W. Williams, yet the project is one of very slender merit; and so hard are its perfections to be discovered that Mr. Williams has had to write an octavo volume to point them out. This furnace, which we need not delineate, differs in scarcely any respect from the previous schemes of Gregson and others, except in the single feature of admitting the air by many holes instead of by two or three; but even this innovation had been brought into use before the date of Mr. Williams' plans, though, indeed, it is hardly worth while to rob him of the praise of this originality, seeing how small must be its value. Mr. Williams says his is not a smoke-burning furnace, and we are sorry to hear it. It is certainly a smoke generating furnace, and if the smoke be not *burned* it must pass off unconsumed. We know, indeed, that it will be argued that it is *gas*, and not *smoke*, that this furnace produces, and we have not the least objection to call the aëriform matter passing over the bridge by that name if it gives Mr. Williams any gratification. But in that case it is obvious that it must have been gas that Mr. Gregson, and others of his fraternity, burnt also; so that Mr. Williams' scheme is as far from enjoying any distinction on that score as ever, whatever name be given to its gaseous products. It is no doubt better, if air is to be admitted into the flues of a boiler, that it should be let in by many orifices instead of by one or two; and it would, we think, be a further improvement to *divide the smoke in the same manner*. But in whatever way the air be admitted, the aëriform matter is the same in Mr. Williams' furnace as in any other; and to pretend that a mere difference in the number of holes can change its nature, is just about as absurd as it would be to allege that water would be turned into wine by passing it through a sieve."

The above was written many years ago. What is the latest opinion of a competent authority "as to the *efficacy* of Mr. Williams' plan for the prevention of smoke?"

In the case of Goodall, at the Police Court at Clerkenwell, reported in the *Times* but a few days ago, Mr. Wright, the government inspector, is reported to have said:—"The apparatus in use is Mr. Williams' apparatus, but although it is one of the original inventions, it fails oftener than any other." The fact that an apparatus succeeds in one place and not another, is itself proof that success is not the effect of the apparatus, but of conditions which exist in some places and not in others.

Mr. Williams joins issue with me on the point as to whether chemistry or mechanics is the more important science connected with furnaces. If the chemist could supply us with a new fuel, or change the nature of that we now use, I would at once place that science in the first rank, but, sir, when I find that no such change is made, and that the effect to be produced depends upon mechanical arrangements, and not chemistry, then I am justified in giving the place of honour to the mechanician and not to the chemist. But that is not the true issue; it is, whether Mr. Williams be right or wrong in his assertions, "that smoke once formed cannot be consumed, and that to prevent it, the supply of air must be admitted above the fuel, in jets or films." These two points are all that distinguish Mr. Williams from other inventors or writers on this subject. As to the manner of admission, Mr. Williams has not ventured to impugn the decision of his own witness, Mr. Houldsworth, and as to the terms *prevention* or *combustion* of smoke being the more correct, I hope I have made it clear that smoke, though once formed, may be *consumed*, aye, CONSUMED. I do not know a writer on any scientific subject, whose use of terms is so loose as Mr. Williams'. If he burns *gas* and not *smoke*, what kind of gas is it? There are many gases. If it be coal gas, that is carburetted hydrogen, which, Dr. Reid says, is largely mixed mechanically with black smoke. I really gave Mr. Williams credit for greater ability and a better cause, than to be driven, not to misquote me, but to pretend not to understand me, when I said, "Smoke is a compound of soot, dust, steam, and *gas*, of the same description as is supplied by the gas companies." Will Mr. Williams deny that the gas so supplied is carburetted hydrogen, and will he further deny that that gas is mixed mechanically with black smoke, not when supplied to him, but when smoke is discharged from a furnace? But, suppose the gas companies did not purify the products of distillation in the retorts, but distributed them as they are thrown off from the coal, what would Mr. Williams call the stuff that would then issue into his house?

Further, how does Mr. Williams now despise the eye, which he formerly called "that INFALLIBLE corrector of fallacies." What can be more fallacious than Mr. Williams' method of suppressing the smoke nuisance. If he be right, there is no such thing as vast volumes of blacks. It appears, from his analysis, that in smoke the visible matter is, compared with the invisible, "*utterly insignificant*." The elements of smoke, according to Mr. Williams, are:—*steam*, in *enormous* quantity, invisible and incombustible; *nitrogen*, also invisible and incombustible; *carbonic acid*, likewise invisible and incombustible; lastly, an "utterly insignificant" quantity of *carbon*, *visible*, but incombustible. If this be so, what has become of all the combustibles which Dr. Reid found in smoke? Mr. Williams thinks I have been led away by the once-prevailing error of imagining that all coloured vapours coming from burning substances are smoke. Has Mr. Williams forgotten a work written and published some ten years ago, entitled "On Increasing the Evaporative Power of Boilers"? Is it not the fact that at page 47 of that work, colour is mentioned as the only test in the furnace of the nature of gases, and is not the eye, at page 53 of that same work, called "that infallible corrector of theoretic fallacies."

I can assure Mr. Williams, that some years ago I carefully perused the first edition of his work, with a view to learn how to prevent smoke; but I rose from its perusal without having acquired one practical idea. I can assure him, moreover, that I have seen numbers of furnaces erected on his patent, and that their action in preventing smoke was identically the same as that of furnaces constructed according to the plans of those who professed only to prevent smoke issuing from the chimney by consuming it in the furnace.

As soon as the last edition of his work appeared I purchased it, and do not now regret the investment, but esteem it highly as a work from which much may be learned, but all that is peculiar to Mr. Williams' expired patent is practically worthless; and the assertion that smoke may be prevented from forming, but cannot be consumed if once formed, is, in Mr.Williams' own very expressive language, a "theoretic fallacy."

Though distressed by the length to which this paper has extended, I cannot conclude without giving an analogical argument to show how much more important it is to know how to cure an evil than merely to know what that evil is.

A furnace may with much propriety be likened to the human lungs, and a furnace with an insufficient draught may be likened to a person afflicted with shortness of breath, whether from asthma, bronchitis, or other diseases. In the case of the furnace the *breath* will, by its *blackness*, indicate the nature of the trouble, viz., the want of oxygen, and in the human sufferer the want of oxygen will be indicated by the convulsive efforts to obtain a supply for the decarbonising of the blood. Now men of science can tell exactly how much oxygen is required to combine with a certain quantity of carbon, but is the value of that knowledge at all to be compared with that of the man who can tell the patient how he can obtain an adequate supply?

There is such a thing as too much learning,—too much theorising, without having the ideas checked by practice. That, sir, is Mr. Williams' unfortunate condition. With a person in such a state of mind it is needless to contend so far as benefit to himself is concerned; but some service may be done by exposing his errors, and showing the estimation in which his opinions are held by such competent critics as Mr. Bourne.

Mr. Williams has become so theoretically exact as to be practically absurd. For example, in a note at foot of page 7 of his work he takes Dr. Lardner to task for saying that coal, when dropped into a furnace, is ignited. According to Mr. Williams, "*Coal gas* may be converted into flame, and *coke* may be ignited, but *coal* can neither be ignited nor converted into flame." The theoretical accuracy and practical value of this distinction is at par with his oft-repeated assertion that smoke is gas, and that, though smoke cannot be burned, gas may.

I am, sir, yours, &c.,
G. W. MUIR.

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

Par. No.

Delivered on 9th March, 1855.

88. Vaccination—Copy of Memorial.
93. Metropolitan Buildings Act—Return.
94. Promotion and Retirement (Ordnance)—Copy of the Royal Warrant.
108. Tyne Conservancy—Correspondence.
109. Railway and Canal Bills Committee—1st Report.
52. Bill—Public Libraries and Museums (amended).

Delivered on 10th and 12th March, 1855.

95. Wheat, &c.—Return.
96. Savings Banks—Account.
97. Victoria—Copy of an Order of Council.
91. Blind Inmates of Workhouses (Ireland)—Abstract of Returns,
106. Incumbered Estates Court (Ireland)—Return.
107. Charity Commission—2nd Report.
112. Committee of Selection—5th Report.
110. Local Acts—(1. Belfast and County Down Railway; 2. Carlisle and Silloth Bay Railway and Dock; 3. Carmarthen and Cardigan Railway; 4. Cork and Youghall Railway; 5. Glasgow, Dumbarton, and Helensburgh Railway; 6. Stockton and Darlington Railway; 7. Swansea Vale Railway)—Reports from the Admiralty.

Delivered on 13th March, 1855.

101. Hops—Account.
102. Malt, &c.—Returns.
103. Brewers—Return.
104. Wool and Woollen Manufactures—Returns.
111. District Lunatic Asylums (Ireland)—Account.
115. Theological Professors, &c. (Belfast)—Amended and Supplemental Returns.

Delivered on 14th March, 1855.

War with Russia—Despatches from the Secretary of State in Reply to Communications from Governors of British Colonies.

SESSION 1854.

448. Indexes to Reports of Commissioners, 1832-1854 (Parliamentary Representation).

Delivered on 15th March, 1855.

85. Revenue Departments—Estimates.
105. Sewers (Houses of Parliament)—Report of Mr. Gurney.
53. Bills—Militia (Ireland.) (Amended)
55. Bills—Vacating of Seats in Parliament.

Trade and Navigation—Annual Statement.
Loss of the "Charlotte"—Report of an Investigation by Commander Robertson.
Lodging Houses (Metropolis)—Report by Mr. George Glover.
General Board of Health (Operation of Pipe Sewers)—Reports, &c.

Delivered on 16th March, 1855.

111. District Lunatic Asylums (Ireland)—Return. (A corrected Copy).
114. Education (Ireland)—Return.
116. Army (Regulation Price for the Purchase of a Commission, &c.)—Return.
117. Malt—Return.
118. Harbours, &c.—Report from the Board of Trade.
54. Bills—Price's Indemnity.
56. Bills—Marriage Law Amendment.
57. Bills—Friendly Societies. (amended.)

Delivered on the 17th and 19th March, 1855.

100. Barnstaple Election Petition—Minutes of Evidence.
121. Railway and Canal Bills—Report of the Board of Trade.
123. Lieut. General the Earl of Lucan—Correspondence.
58. Bill—Burial Grounds (Scotland)

Statistical Abstract for the United Kingdom, 1840 to 1854.
General Board of Health (Epidemic Cholera in the Metropolis in 1854): Dr. Sutherland's Report, &c.
Maynooth Commission—Report and Appendix; Part 1.
Maynooth Commission—Minutes of Evidence; Part 2.
Sardinia—(Co-operation in the War—Acts and Conventions.)

MEETINGS FOR THE ENSUING WEEK.

MON. Actuaries, 7. Mr. Charles Jellicoe, "An Examination of the Objections urged against the Plan of Decimal Coinage proposed by the Royal Commissioners and the Select Committee of the House of Commons.
Geographical, 8½. 1. "Extract of a Letter from Admiral Matthieu, on the Progress of the Survey in the Straits of Gibraltar." 2. "Despatch from Loanda respecting Dr. Livingston's Exploration in Central Africa." 3. Don Vicente T. D. B. Castellanos, "On the Ruins of Tical, near the Lake of Peten, in Central America."
TUES. Royal Inst., 3. Prof. Tyndall, "On Electricity."
Meteorological, 7. "On the recent Cold Weather, and on the Crystals of Snow observed during its continuance."
Civil Engineers, 8. Discussion upon Mr. Robinson's paper, "On the Application of the Screw Propeller to the Larger Class of Sailing Vessels."
Lond. Inst., 8. Mr. B. Waterhouse Hawkins, "On the Restoration ef the Extinct Animals at the Crystal Palace." (Illustrated.)
Medical and Chirurgical, 8½.
Zoological, 9.
WED. Royal Soc. Literature, 4½.
Society of Arts, 8. Dr. W. H. Smith, "The Utilisation of the Molten Mineral Products of Smelting Furnaces."
Microscopical, 8.
THURS. Royal Inst. 3. Mr. Donne, "On English Literature."
Antiquaries, 8.
Royal, 8½.
FRI. Chemical, 8. Anniversary.
Royal Inst. 8½. Rev. J. Barlow, "On the Application of Chemistry to the Preservation of Food."
SAT. Royal Inst. 3. Dr. Gladstone, "On the Principles of Chemistry."
Medical, 8.

PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, March* 16*th*, 1855.]

Dated 26th January, 1855.

197. W. Binns, Claremont-villa, Brompton, and J. Haughton, Oldham—Valves.

Dated 10th February, 1855.

313. E. Sparkfield, 142, Cheapside—Exhibition of pictorial representations.

Dated 28*th February*, 1855.

433. A. Symons, Strand—Egg-cooking apparatus. (A communication.)
435. F. Allarton, High-street, Southwark—Administering iron as a remedy.
437. J. Higgin, Manchester—Treating waste-soap liquors.
439. C. F. Stansbury, 17, Cornhill—Ringing fog-bells. (A communication.)
441. G. M. Miller and J. Wakefield, Dublin—Pistons.
443. F. A. Wilson, Kennington—Closing and unclosing bottles.
445. H. C. Jennings, 8, Great Tower-street—Soap.
447. G. Ritchie, New-cross—Dress linings.
449. B. Blackburn, Clapham-common—Pipes.

Dated 1*st March*, 1855.

450. R. A. Brooman, 166, Fleet-street—Rollers used in spinning. (A communication.)
452. S. Vigoureux, Rheims—Printing, &c., textile fabrics.
453. T. Sadleir, Tullamore—Manufacturing charcoal.
454. G. M. Miller, Dublin—Railway axles and axles boxes.
455. A. Small, Glasgow—Marine compasses.
457. J. H. Johnson, 47, Lincoln's-inn-fields—Rolling and shaping metals. (A communication.)

Dated 2*nd March*, 1855.

458. J. Lewis, Abergavenny—Stench-traps.
459. T. Dodds, and R. Leake, 4 Horse Shoe-court, Ludgate-hill, and W. Fletcher, 2, St. James-street, Old Kent-road—Machine for heating furnaces.
460. G. Lowry, Manchester—Spinning machinery.
461. C. J. Dumery, Paris—Steam-whistles.
462. C. F. Stansbury, 17, Cornhill—Drill and bit stock. (A communication.)
463. J. H. Johnson, 47, Lincoln's-inn-fields—Slide valves. (A communication.)
464. W. Hodges, Stafford—Boots and shoes.
465. J. Johnson, Bow—Temporary rudders.
466. W. G. H. Taunton, Liverpool—Pumps and their gear.
467. A. V. Newton, 66, Chancery-lane—Printing-presses. (A communication.)
468. J. Correy, Birmingham—Gun lock.

Dated 3*rd March*, 1855.

469. J. Woodley and H. H. Swinford, Limehouse—Fire alarum.
470. A. B. Vabro, St. Thomas'-street East—Floors and roofs. (A communication.)
471. B. Dickinson and J. Platts, Huddersfield—Finishing machinery for textile fabrics.
472. W. Hunt, Tipton—Utilising compounds produced in galvanising iron.
473. T. H. Ryland, Birmingham—Neck and dress chains, bracelets, &c.
474. W. Johnson, 47, Lincoln's-inn-fields—Cleansing and preparing fibrous materials. (A communication.)
475. J. Revell, Duckinfield—Propelling vessels.
476. J. O. Williams, Torquay—Camp stoves and cooking apparatus.
477. T. Metcalfe, High-street, Camden-town—Window sashes.
478. R. Boby and T. C. Bridgman, Bury St. Edmunds—Corn dressing and winnowing machines.
479. T. W. Carter, Massachussetts—Firearms. (A communication.)
480. C. Iles, Birmingham—Polishing, &c., metal substances.
481. C. Iles, Birmingham—Door furniture, castors, and cotton reels.

Dated 5*th March*, 1855.

483. L. J. Paine, Camberwell, and J. Ryan, Hatcham—Portable utensils for containing liquids.
485. I. Dawson, Northwich—Saddles.
487. R. A. Brooman, 166, Fleet-street—Projectiles. (A communication.)
489. J. Lewis, Elizabethtown, New Jersey—Rigging and sparring vessels.
493. A. E. L. Bellford, 32, Essex-street, Strand—Oscillating steam-engines. (A communication.)

Dated 6*th March*, 1855.

495. W. Jenkins, Neath Abbey—Casting copper cylinders, &c.
497. G. W. Bowlsby, Castle hotel, Oxford-street—Closing windage when discharging cannon.
499. A. J. Burr, 42, Alfred-road, Paddington—Gas meters.
501. E. Tardiff, Bruxelles—Numbering apparatus.

WEEKLY LIST OF PATENTS SEALED.

Sealed March 16*th*, 1855.

2029. Victor Athanase Pierret, Paris—Improvements in watches and clocks.
2037. Henry Hudson, Flint Glass Works, South Shields—Improvements in the manufacture of vessels for measuring fluids.
2039. Jean Antoine Passet, Paris—Improved machinery or apparatus for pressing or calendering fabrics.
2047. Peter Spence, Pendleton—Improvements in obtaining sulphur from iron pyrites, and other substances containing sulphur.

Sealed March 20*th*, 1855.

2043. James Egleson Anderson Gwynne, Essex Wharf, Essex-street, Strand—Improvements in machinery for lifting, forcing, and exhausting.
2048. George Collier, Halifax, and Samuel Thornton, Rochdale—Improvements in looms for weaving.
2055. Robert Pinkney, 26, Long-acre—Improvements in stoppers, corks, or valvular apparatus for bottles or receptacles for liquids, and in the machinery or apparatus employed for making the same.
2058. Henry Alexandre Genetreau, Paris—An improved system of carriage shafts, poles, or beams.
2061. Philip James Chabot, Spitalfields—Improvements in supplying air to furnaces.
2063. Henri Catherine Camille de Ruolz, and Anselme Louis Marie de Fontenay, Paris—Improvements in the treatment of certain metals for producing an improved metallic alloy.
2065. Joshua Bacheler Halsey, 4, Norfolk-street, Strand—An improved machine or apparatus for crushing and pulverizing ores, and for separating the gold therefrom by amalgamation.
2070. Thomas Clayton, Oldham, and Robert Harrop, Lowside, near Oldham—Improvements in ornamenting wood, and in the machinery or apparatus connected therewith.
2072. Thomas Griffiths, Madeley, Shropshire—An improved pump for raising and forcing water.
2082. John Rogerson and James Brimelow, Bolton—Improvements in certain parts of steam engines.
2125. Wright Townend, Harden Bingley—An improvement in combing wool and other fibres.
2140. William Bridges Adams, 1, Adam-street, Adelphi—Improvements in rails for railways, and in the connections and fastenings for rails.
2144. William Frost, Wine Office Court, Fleet-street—Improvements in steam engines.
2152. William Chambers, Hampson-mill, near Bury—Improvements in machinery for beetling cotton and other fabrics.
2159. Robert Maynard, Wittlesford—Improvements in machinery for threshing and dressing grain.
2171. William Chubb, Clifton—Improvements in the construction of beams and parts of ships, ships' masts and spars, and other like structures.
2224. Richard Green, 12, Sydney-street, Brompton—Improvements in propelling vessels.
2274. Richard Hugh Hughes, 95, Hatton-garden—Improvements in transmitting motive power.
2279. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in circular looms—(A communication.)
2309. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in axle boxes. (A communication.)
2362. Leone Glukman, Sackville-street, Dublin—Improvements in effecting electric communications in railway trains.
2583. Thomas Brown and Peter MacGregor, Manchester—Improvements in machinery or apparatus for cutting velvets or other similar piled fabrics.
2602. William James Harvey, Exeter—Improvements in fire-arms when revolving barrels are used.
2645. Robert Adams, King William-street—Improvements in fire-arms called revolvers.
2751. Thomas Thorneycroft, Wolverhampton—Improvements in ship-building.
82. Joseph Ray Hodgson, Sunderland—Improvements in the construction of anchors.
165. John Henry Pape, Paris—Improvements in pianofortes.
166. Robert Johnston, Drums-lane, Lock-street, Aberdeen—The use of certain portions of fish in the manufacture of soap.
170. William Kilgour, Liverpool—An improved manufacture of naphtha, paraffine, and paraffine oil.
191. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the construction and arrangement of electric telegraphs, and in the application thereof—(A communication.)
196. John Lamacraft, Westbourne-grove—Improvements in envelopes or means for securing letters, notes, and similar documents.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Proprietors' Name.	Address.
3695	March 19.	Improvements in Beer Engines	James Deacon	St. John-street, Clerkenwell.
3696	„ 20.	Letter Damper and Stamper	Hardy and Jolly..............	Denby-road, Westbourne grove.
3697	„ „	Throstle or Mule Spring for the Under Clearers of Spinning Machines	William Standring............	Rochdale, Lancashire.
3698	„ „	Fixed Light Oil Burner	James Bower Harman	11, Bucklersbury.